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AMERICAN BREEDERS MAGAZINE

A JOURNAL OF GENETICS

Selection through Advanced Register Records
M. W. HARPER

Inheritance of Left-Handedness
H. E. JORDAN

A System of Numbering Individuals
MOSSOM M. BOYD

The Karakul Breed of Sheep
C. C. YOUNG

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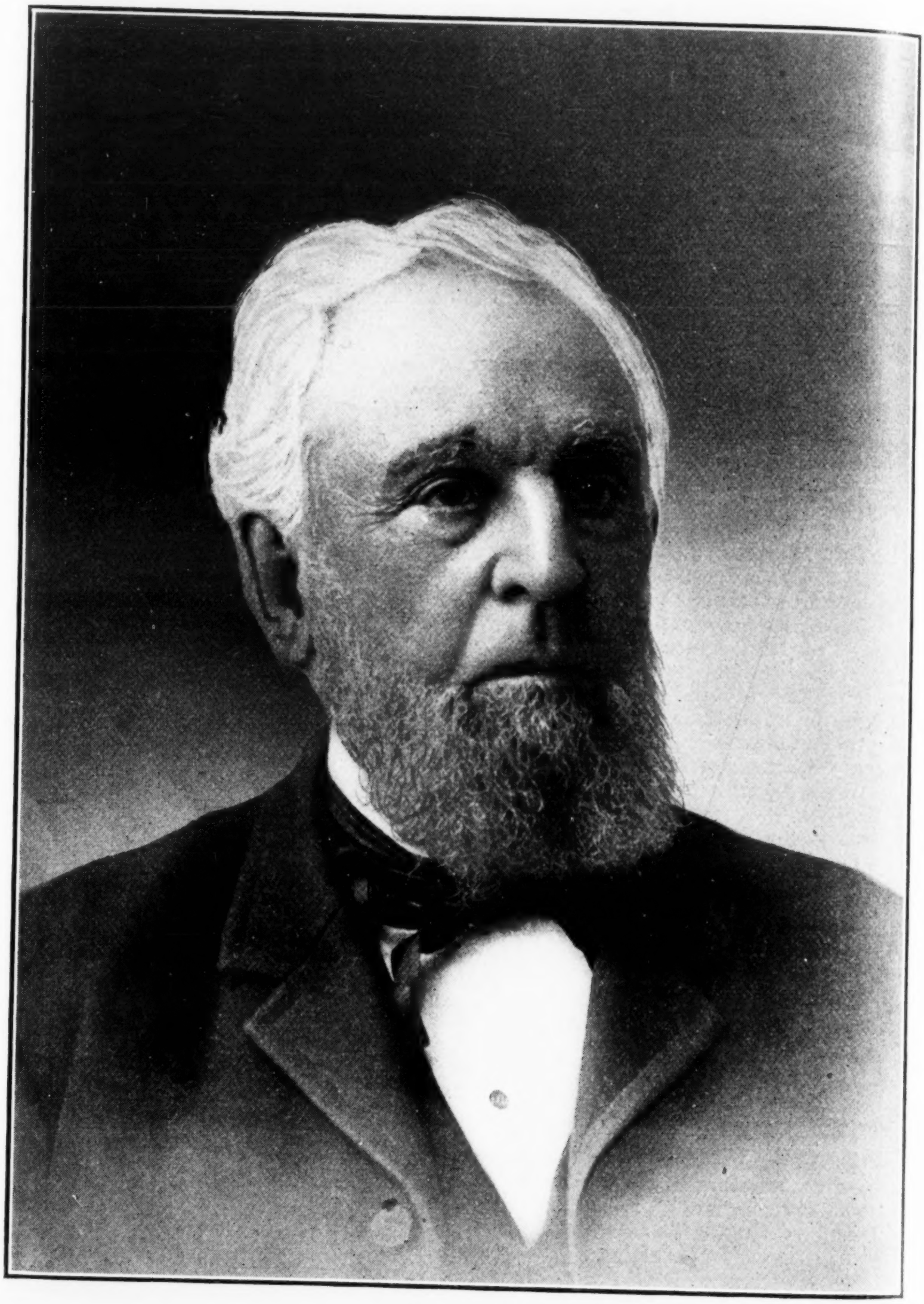


T. L. Miller

THE AMERICAN BREEDERS MAGAZINE

"He was of those whose skill assigns the prize
For creatures fed in pens, and stalls and sties;
And who in places, where improvers meet
To fill the land with fatness, had a seat;
Whose plans encourage, and who journals keep,
And talk with lords about a breed of sheep."—CRABBE.

Vol. II First Quarter, 1911 No. 1

MILLER, DRYDEN, AND WARFIELD

The introduction into America of the various breeds of pedigreed live stock would make an interesting chapter both of the history and the philosophy relating to breeding.

Most of these breeds have come from Great Britain and the British Isles, and almost entirely through private initiative. What public aid was extended consisted in permitting the entry of breeding stock free of duty. In many cases the introduction of a new breed has been made in the face of opposition. The American breeders have rather depended upon the Old World to originate different breeds of live stock, and with a comparatively few exceptions have not originated breeds in either the United States or Canada.

Many men have gained prominence through the work of improving pedigreed animals from Europe and in winning for them a place in the live-stock production of this country. Others have gained prominence and wealth through making those slower improvements which come with small gradual changes after a breed has been originated. Not a few of these breeders were gifted and many sided and combined authorship and other public work relating to the improvement of our live stock with their farming and their breeding of pedigreed live stock.

As to why the British Isles should have been so active in developing breeds and the United States and Canada should have so nearly confined their efforts to widely utilizing these breeds is not wholly a puzzle. In England, for example, the live-stock growers of a county, having gotten into the habit of showing the best of their flocks at the county fair, are in reality in a community group almost as if

they were coöperating. If any outstanding animal gained a reputation for remarkable progeny this fact was clearly brought out at the county fair and all the other breeders would seek some of his get to try out in their own herds. If great excellence in the second generation of this progeny again proved the mutating excellence of a given sire, or dam, the whole countryside would begin to take an interest in that particular strain of blood. In this way, decade by decade, new breeds with high power to project their qualities into purebred or grade progeny were built up.

These breeds made the British Isles the most famous live-stock center in the world. They brought fine profits to the farmers and breeders through the sale of purebred animals for export to the United States, Australia, Argentine, and many other countries. These breeds provided even a larger profit through the splendid live stock they furnished for the farmers of the Islands themselves. And the success which came from gaining recognition for the most skillful breeding done in the world, as evidenced by the high prices paid by foreign visitors for British live stock and by the high profits on the live-stock farms of those Islands, gave an inspiration to country life which has done much to build up the rural people.

T. L. MILLER

1817–1900

One of the men who have to their credit the chief honor of introducing, against opposition and every conceivable form of difficulty, a valuable breed of live stock was T. L. Miller, of Beecher, Ill. Following Mr. Wm. H. Sotham, the pioneer importer and breeder of Hereford cattle, he became a great champion of this rival breed of the theretofore nearly dominant Shorthorn. Those interested in the different families of Shorthorns could see no good in the new breed. In shows, in the sales ring, and in the agricultural and live-stock press there arose a heated contest. During the eighties this contest waged especially strong. In those days these two breeds were striving for the market for purebred males with which to grade up the then rapidly extending ranch cattle of the short-grass country east of the Rocky Mountains. That market placed no premium on dairy products. The dual-purpose tendencies of the Shorthorn placed it rather at a disadvantage as compared with the Hereford, and to the everlasting loss of the Shorthorn breed the contest with the Hereford for supremacy on the plains caused Shorthorn breeders to

JOHN DRYDEN

give relatively too much prominence to the blood of Cruikshank's wonderfully mutant sire, Champion of England, until now it is difficult to find in the United States enough Shorthorns with real dairy heredity to serve as a base of a dairy Shorthorn sub-breed.

Mr. Miller had no intention of injuring the Shorthorn breed. His purpose was to introduce and improve the Hereford breed, and with an indomitable energy he labored at that task.

He wrote much for the agricultural papers. For a time he published a periodical devoted especially to Herefords. For a number of years he published the American Herd Book of Hereford Cattle, and when this enterprise grew too large to be carried on privately he turned it over to the Hereford Society.

He wrote a "History of Hereford Cattle," a book of some five hundred pages, finishing that task just before his death. This book was published by Mr. T. F. B. Sotham, son of his old-time coworker, Wm. Sotham.

Mr. Miller was born in New England, but not on a farm: he learned the trade of a butcher, engaged in commercial operations, and later was successful in the insurance business in Chicago. He seems to have wearied of city life, and settled on a farm of a thousand acres at Beecher, Ill., some thirty miles from Chicago. He is an instance of those whose business talents assure success in whatever they undertake, farming not excepted.

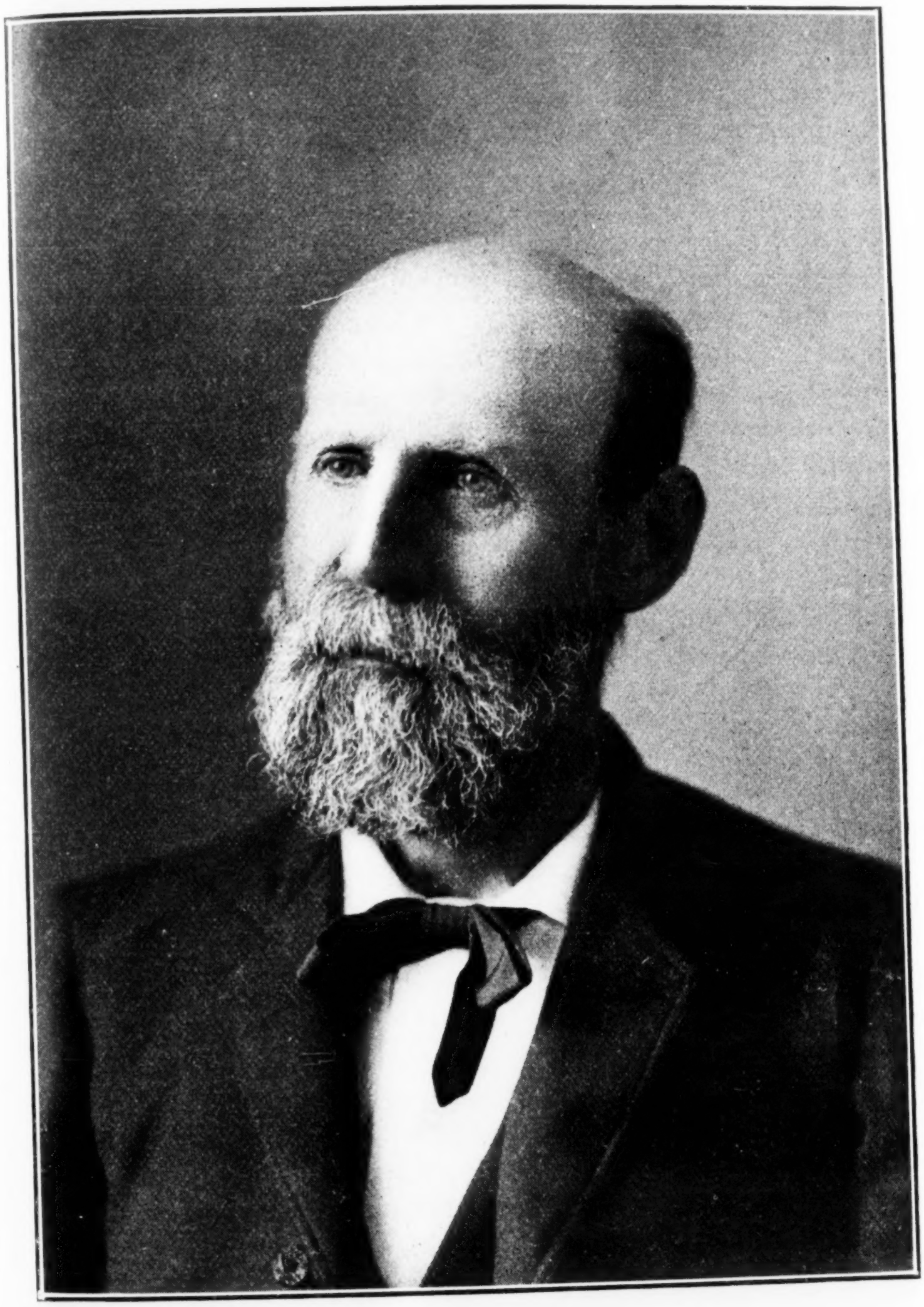
JOHN DRYDEN

1840–1909

One of the men who labored to improve our imported breeds of pedigreed live stock, almost to the point of creating new breeds or sub-breeds, was John Dryden, a native of the Province of Ontario, who became a very successful farmer near Toronto. Of his farm it has been said that it was "the best worked and best operated farm in America." His farm specialties were the breeding of Shorthorn cattle and Shropshire sheep. His breeding work constantly tended in the direction of a more scientific system of breeding.

Through that period of Shorthorn history during which the sentiment for "fashion" often overshadowed the more fundamental principles of sound breeding, his steadying influence made itself greatly felt.

Mr. Dryden served as president of the American Shropshire Registry Association, also as president of the Dominion Shorthorn Breeders Association, although his most important public work was



William Warfield

as Minister of Agriculture for Ontario during the years 1890 to 1906. During that period he was a leader of much of the agricultural development of the province, and especially along live-stock lines. It was he who, during his administration, encouraged the development of the bacon breeds of hogs in that province, and especially the improved Yorkshires, with the result that methods of breeding and handling to produce bacon of high quality were successfully worked out.

Mr. Dryden and his associates, through the Guelph winter live-stock show, where prizes were given not only for live animals but also for carcasses showing high bacon type, remarkably improved these breeds from the standpoint of the breeder who seeks the long, uniform side of bacon with its alternating layers of lean and fat.

This work, done in relation to the Canadian effort to lead in foreign markets for bacon, stands out as one of the remarkable achievements in American live-stock breeding.

Mr. Dryden's many friendships in the States attested his lovable character and formed one of the innumerable ties between the two countries.

WILLIAM WARFIELD

1827–1907

One of the characters most prominent during the years in which Kentucky supplied much of the Shorthorn blood to the breeding herds of this famous breed throughout the United States was William Warfield of Lexington, Kentucky.

Mr. Warfield came of old Maryland stock, his grandfather, Elisha Warfield, having migrated from Annapolis, Maryland, and settled near Bryant Station, famed from the days of Boone. There he began the breeding of Shorthorns and fine horses. His son Benjamin, father of William Warfield, though he studied to practice medicine, found the love of the farm and of live stock so strong that he forsook medicine for the breeding of Shorthorns, establishing his herd in 1826.

William Warfield's education was also thorough, including a partially completed course in medicine. Again the taste for rural pursuits and the love of cattle decided the son upon a career upon the land. His farm, "Grassmere," in the bluegrass region, the farm on which he was born, became the seat of his life activity as a breeder of Shorthorn cattle. His most active period was during the seventies and eighties, when the farmers of Kentucky, Ohio, and westward began extensively to improve their stock by the use of purebred cattle and many established herds of pedigreed Shorthorns.

Mr. Warfield stands out as one of the best informed men on Shorthorn history and Shorthorn pedigrees. He contributed much to live stock and especially to Shorthorn literature, and his fund of information was at all times at the command of those who were in need of assistance.

His two most notable contributions to live-stock literature were the books "History of Improved Shorthorn Cattle" and "The Theory and Practice of Cattle Breeding."

He was a strong believer in the possibility of improving Shorthorns and other live stock in our own country. He placed great emphasis upon the possibilities of breeding as compared with continuous importation.

Among Kentucky's many leading live-stock farmers, Mr. Warfield stands prominently as one of a race of noblemen of strong and lofty character. As his ancestors by the force of their character were leaders in their communities, so he was respected, honored, and loved by that wider circle which knew him through the sales ring, the live-stock show, and the printed page.

PROGRESS IN SELECTION AS SHOWN BY ADVANCED REGISTER RECORDS

M. W. HARPER

New York College of Agriculture, Ithaca, New York

"Breeding for production in dairy cattle in the light of recent advances in the study of inheritance" is the subject of a very interesting paper recently from the pen of a well-known biologist.[1] The paper calls to our attention some very important data for the study of inheritance; data, the economic value of which cannot be easily overestimated, as they affect the production of a useful product. From a biologic point of view they may be of no greater importance than the beard on a head of wheat, the length of a rat's tail, the color of a guinea pig's fur, or the steps of a Japanese dancing mouse, but from a productive point of view they are of very great importance to mankind. The data, such as therein presented, when extended and properly interpreted, seem to offer, in part at least, a solution of the best method of breeding for increased dairy production as well as to throw some light upon a much discussed biologic question, at least so far as the breeding of the farm live stock is concerned. In view of this it seems worth while to give the paper more than passing notice.

It is not the purpose of this paper to enter into a battle of words, to coin new terms or to define old ones, to propose theories of evolution and the like, but to set forth the facts as they exist at the time the data herein are collected. One thing, kindly remember that this article is prepared by a practical breeder. While in evolution time is of no consequence, with the breeder it must be taken by the forelock. The breeder must, therefore, work faster than nature; he cannot make use of the leisurely operating evolutionary methods of nature. The action must be accelerated or its cumulative effect exaggerated.

Source of the data, Jersey Club's Register of Merit.—The paper referred to takes the records of production of Jersey cows as recorded in the Register of Merit, the official organ of the American Jersey Cattle Club, as the data for discussion. In 1903 the Jersey Cattle

[1] Raymond Pearl. "Breeding for Production in Dairy Cattle in the Light of Recent Advances in the Study of Inheritance."

Club began making official tests of Jersey cows and admitting such animals to the Register as could meet the requirement. In 1908, or five years after its establishment, the first volume of the Register of Merit appeared containing the records of 361 cows. The cow is eligible to the Register of Merit on her own performance alone, whereas the bulls are required to have a certain number of daughters in the Register before they can be recorded. The reason for this is obvious, as bulls do not themselves produce milk.

The paper raised the question, "How have the existing *Advanced Registry* cows been bred as a matter of actual fact?" The importance of a correct answer to this question is admitted, for if we are in possession of this knowledge we may breed some more like them. In the paper an attempt was made to obtain information on this question by tabulating the last 162 cows (Register of Merit Nos. 200–361 inclusive). For convenience of study these cattle were divided into four classes according to the possible kinds of mating, with the results shown in the following table:

TABLE 1.—*Breeding of* 162 *Jersey cows in Register of Merit.*

Description of parentage.	Number of Register of Merit cows resulting from stated parentage.	Percentage each form of parentage bears to total.
Sire in Register of Merit; dam in Register of Merit	11	7
Sire not in Register of Merit; dam not in Register of Merit	68	42
Sire in Register of Merit; dam not in Register of Merit	70	43
Sire not in Register of Merit; dam in Register of Merit	13	8
Total	162	100

The following conclusions are drawn from the table: "Too much stress should not, of course, be laid on these figures. As they stand they have no great scientific value. They suggest a whole series of questions which need more data for their final solution. *But the only point which it is intended to bring out here is that the practical breeder will have a great deal of difficulty in finding anything in these figures to indicate that he will be likely to produce more heifer calves that will qualify for the Register of Merit if he breeds from only Register-of-Merit stock than he will if he breeds from non-Register-of-Merit stock.*" In this connection there are two more statements to which attention is directed: (1) "The cow in Advanced Registry has shown nothing except that she is a good milker. She may be and too often is absolutely worthless as a breeder." (2) "There have

been many Jersey cows that were greater milk producers than was Figgis or Marina Pogis, but how many of them can produce a son that will get nine or fifteen daughters in the Advanced Registry?"

Jersey cow butter tests.—Not only are the above data incomplete but they are built upon an entirely erroneous assumption; namely, that all Jersey cows outside the Register are poor producers and not in the Register because they fail to meet the requirements. As a matter of actual fact there are many good Jersey cows not in the Register of Merit simply because they have never been tested. They could make the requirements but are not given the opportunity. In this connection it should be remembered that cows from without are continually being tested and brought into the Register of Merit, which will of necessity mean that there are cattle in the Register that do not have Advanced Registry parentage. The percentage of such animals will simply depend on the number admitted from without.

The larger the number of cows admitted from without the smaller will be the percentage with both sire and dam in the Register of Merit. When the Register was established in 1903, it must of necessity follow that all the animals admitted the first few years had neither sire nor dam in the Register. As years go by, the offspring of the cows first admitted make records and are themselves admitted, with the result that after the Register has been in existence for a period of years a good percentage of the cows in the Register of Merit will have parents in the Register also. An extension of the data in the above table will show this.

While the Register of Merit was established in 1903 and hence of recent origin, butter tests among Jersey cows have been made since the seventies, during which time many Jersey cows have been tested and records preserved. Two volumes of these records have

TABLE 2.—*Breeding of* 162 *Jersey cows in Register of Merit.*

Description of parentage.	Number of Register of Merit cows resulting from stated parentage.	Percentage each form of parentage bears to total.	Including butter tested, in earlier records.	
			Number of cows.	Per cent of cows.
Both sire and dam in Register	11	7	57	35
Neither sire nor dam in Register	68	42	39	24
Sire in Register; dam not	70	43	53	33
Dam in Register; sire not	13	8	13	8
Total	162	100	162	100

been published; the first, August 1, 1898, and the second, July 15, 1902. By following back the data for the same 162 cows and taking into account the butter tests, we get Table 2 on opposite page.

A study of the table including Jersey cows with butter tests shows that the per cent of cows with Advanced Registry parents has risen from 7 to 35 while the per cent of cows with neither sire nor dam in the Register has fallen from 42 to 24. With these facts before us it would seem that our chances of getting an Advanced Register heifer from an Advanced Register cow have been much improved. At the same time our chances of getting an Advanced Register heifer from cows without records have diminished.

Holstein-Friesian cows.—During the year 1894 the Holstein-Friesian Association established the Advanced Register, in which are registered individuals of that breed that meet its requirement. Since the establishment of the Advanced Register seventeen years ago, 11,815 cows and 838 bulls have been admitted. With a view to obtaining more information upon the inheritance of milk-producing qualities a study has been made of the breeding of all Holstein-Friesian cows admitted to the Advanced Register during the year ending May 15, 1910. This study included 3,070 cows, of which 2,233 were first records and 837 re-entries; that is, cows increasing a previous record. Classifying the 3,070 cows as before, we have Table 3.

TABLE 3.—*Breeding of* 3,070 *Holstein-Friesian cows in the Advanced Register.*

Description of parentage.	Number of A. R. O. cows resulting from stated parentage.	Percentage each form of parentage bears to total.
Both sire and dam in Register	1,196	39
Neither sire nor dam in Register	710	23
Sire in Register; dam not	770	25
Dam in Register; sire not	394	13
Total	3,070	100

These results are approximately the same as in the extended table No. 2, 39 per cent having both sire and dam in the Register and 23 per cent with neither sire nor dam in the Advanced Register, 25 per cent with sire only and 13 per cent with dam only in the Register.

Holstein cows making 50 per cent above requirements.—As previously stated, there are many cows outside the Advanced Register that if tested would make the requirements, which are very low when com-

pared with high efficiency. Furthermore, there is much variation among cows in the Advanced Register, some barely making the requirements, others attaining much higher efficiency. This suggests the question as to the percentage of high producing cows with Advanced Register parents. This is the real test of efficiency, as the minimum requirements of the Register are not difficult to make. To obtain information on this point all of the cows registered during the year ending May 15, 1910, making 50 per cent more than the requirement have been selected out and are classified in Table 4 below; that is to say, where the requirement is 12 pounds of fat the table includes those making 18 pounds or more.

TABLE 4.—*Breeding of* 1,121 *Holstein-Friesian cows making* 50 *per cent above requirements.*

Description of parentage.	Number of A. R. O. cows resulting from stated parentage.	Percentage each form of parentage bears to total.
Both sire and dam in Register	584	52
Neither sire nor dam in Register	157	15
Sire in Register; dam not	235	20
Dam in Register; sire not	145	13
Total	1,121	100

Here is evidence that, with the requirement increased by 50 per cent, more than half, or, accurately, 52 per cent, of cows making such requirements have both sire and dam in the Advanced Register while only a little over one in six, or 15 per cent, have neither sire nor dam in the Registry; 20 per cent with sire only, and 13 per cent with dam only. This shows clearly that as we raise the requirements the chances of getting an Advanced Register heifer from the outside are quite small while our chances of getting one from one within, if we get one at all, are about one in two.

TABLE 5.—*Breeding of* 168 *Holstein cows making* 100 *per cent abov requirements.*

Description of parentage.	Number of A. R. O. cows resulting from stated parentage.	Percentage each form of parentage bears to total.
Both sire and dam in Register	123	73
Neither sire nor dam in Register	5	3
Sire in Register; dam not	25	15
Dam in Register; sire not	15	9
Total	168	100

Holstein cows making 100 per cent above requirements.—In order to clear this matter up a little more if at all possible, the cows making 100 per cent above the requirements were classified, with results as shown in Table 5 on opposite page:

When the requirements are doubled, 73 per cent of the cows have both sire and dam in the Register while only 3 per cent have neither sire nor dam in the Register. Now, our chances of getting an Advanced Register heifer from the outside are only three in one hundred while our chances of getting one from within, if at all, are almost three in four. Thus it would seem that the time-worn expression "blood will tell" has again proven its right to remain the breeder's watchword.

Holstein-Friesian cows with records as breeders.—Since the assertion was made that the cows in the Advanced Register have shown nothing except that they are good milkers and that they may be and too often are absolutely useless as breeders, it seems worth while to look to the records and determine if possible the exact standing of Advanced Register cows as breeders. While data on this are somewhat difficult to obtain, some idea of the Advanced Register cow as a breeder may be obtained from Table 6, which is a classification of cows that have produced two or more and four or more daughters with records.

TABLE 6.—*Breeding of* 1,999 *and* 172 *Holstein-Friesian cows with two or more and four or more A. R. O. daughters respectively.*

Classification of cows.	Number of cows.	Per cent of cows.
Cows having records and two or more A. R. O. daughters	1,076	54
Cows having no records and two or more A. R. O. daughters	923	46
Total	1,999	100
Cows having records and four or more A. R. O. daughters	122	71
Cows having no records and four or more A. R. O. daughters	50	29
Total	172	100

As shown in Table 6, of the cows with two or more daughters in the Advanced Register, 54 per cent themselves have records, while 46 per cent have no records themselves. If, however, we wish a cow that can produce four or more daughters that can make the Register, the table shows that the chances are about three to one that we will find her in the Advanced Register.

Holstein-Friesian bulls.—As before stated, bulls are admitted to the Advanced Register on the performance of their daughters; that is, when a Holstein bull has four or more daughters in the Register, he is also eligible. During the year ending May 15, 1910, there were 133 bulls admitted to the Register. To aid in the study of transmission of the milk-producing character, these bulls were classified similarly to the cows, resulting in Table 7.

TABLE 7.—*Breeding of* 133 *Holstein-Friesian bulls in the Advanced Register.*

Description of parentage.	Number of A. R. O. bulls resulting from stated parentage.	Percentage each form of parentage bears to total.
Both sire and dam in Register	85	64
Neither sire nor dam in Register	11	8
Sire in Register; dam not	25	19
Dam in Register; sire not	12	9
Total	133	100

It will be seen that 64 per cent of the bulls capable of producing four or more heifers good enough to make the Register have both sire and dam in the Register, while only 8 per cent have neither sire nor dam in the Advanced Register, 19 per cent sire only and 9 per cent dam only in the Advanced Register. This goes to show that if we wish a bull prepotent enough to get four or more heifers in the Register, our chances are much in favor of finding him with both sire and dam in the Register.

Holstein-Friesian bulls in advance of requirements.—As with cows, the requirements admitting bulls to the Advanced Register are not difficult to make. In all 838 bulls have been admitted. The test of efficiency is shown where we raise the requirement. Since the paper referred to raises the question as to the number of cows that can produce sons that will get nine or fifteen daughters in the Advanced Register, nine is first taken as a requirement; then fifteen, and the breeding tabulated with results as in the table below. Again, since getting fifteen daughters in the Register is not very difficult, the standard has been raised to twenty-five or more, then to fifty or more, and lastly to seventy-five or more daughters in the Advanced Register. This should show relative efficiency and if there is anything in selection should demonstrate that fact. The results of such classification show results as follows:

TABLE 8.—*Parentage of sires, each with specified numbers of A. R. O. daughters in Advanced Register.*

	Description of Parentage.	Number of sires.	Per cent of total sires.
251 sires with nine or more A. R. O. daughters each, or 28 per cent of all in Register	Both sire and dam in Register	145	58
	Neither sire nor dam in Register	31	12
	Sire in Register; dam not	46	18
	Dam in Register; sire not	29	12
	Total	251	100
112 sires with fifteen or more A.R.O. daughters each, 13 per cent of all in Register	Both sire and dam in Register	75	67
	Neither sire nor dam in Register	6	5
	Sire in Register; dam not	19	17
	Dam in Register; sire not	12	11
	Total	112	100
43 sires with twenty-five or more A.R.O. daughters each, 5.1 per cent of all in Register	Both sire and dam in Register	31	70
	Neither sire nor dam in Register	0*	0
	Sire in Register; dam not	7	18
	Dam in Register; sire not	5	12
	Total	43	100
14 sires with fifty or more A. R. O. daughters each, 1.8 per cent of all in Register	Both sire and dam in Register	12	86
	Neither sire nor dam in Register	0	0
	Sire in Register; dam not	1	7
	Dam in Register; sire not	1	7
	Total	14	100
5 sires with seventy-five or more A.R.O. daughters each, 0.6 per cent of all in Register	Both sire and dam in Register	5	100
	Neither sire nor dam in Register	0	0
	Sire in Register; dam not	0	0
	Dam in Register; sire not	0	0
	Total	5	100

The results shown in Table 8 are significant. In the first place, it will be noted that 28 per cent of all the bulls in the Advanced Register have nine or more daughters also in the Advanced Register, and that 13 per cent have fifteen or more A. R. O. daughters. In the second place, it is interesting to note how the per cent of bulls with both sire and dam in the Register increases as the requirements are raised. With the requirement placed at 9 A. R. O. daughters, 58 per cent have both sire and dam in the Register, while 12 per cent have neither

sire nor dam, 18 per cent sire only, and 12 per cent dam only in the Register. With the requirement placed at fifteen A. R. O. daughters, the per cent with both sire and dam in the Register has risen to 67, while the per cent with neither sire nor dam has dropped to 5. With the requirement placed at twenty-five A. R. O. daughters, the per cent with both sire and dam in the Register has risen to 70 and there is not a single sire with neither sire nor dam in the Register. In the third place, we note that when the requirement is raised to the maximum, we have all the animals making the requirement with both sire and dam in the Advanced Register.

The number of cattle tested for admission to the Advanced Register is not large. For the past few years only 13 per cent of the Holstein cows and 1.3 per cent of the bulls have been admitted to the Register. This is significant in a study of the data above. When the small number of cows tested and in the Register are taken into account, and the large percentage of high producing animals coming from the Register are considered, the chance of finding a maximum producer from without the Register are not very encouraging. The breeder attempting to produce a Holstein cow with a weekly record of 29 pounds of butter fat, or a bull that can sire 100 A. R. O. daughters, is likely to encounter much difficulty unless he selects parents from the Advanced Register.

In this connection, it may be stated that the Advanced Register plays no part in increasing the production of dairy cows, it neither adds to nor detracts from the production, but is simply an instrument in which records of performance are kept, and from which records of transmitted efficiency can be obtained, nothing more. It is easily possible to build up a strain of high-producing cows without the Register, but practically the same methods that the Register encourages must be employed. The entire matter may be summarized thus:

The Advanced Register contains a record of performance which enables us to know the high-producing from the low-producing cows as well as the cows and bulls likely to get high producers. The low producers are discarded and the high producers are propagated, which procedure, in connection with better care and management, enables us to get still higher producers. Again the low producers are discarded and the high producers propagated, with the result that the average production and the previous maximum production of the race are raised.

Now we are told that this increased production must of course cease when the limit of the physiological activities of the cells is

reached. But who wants to go on record in any hard and fast setting of the metes and bounds that may or may not limit the working of evolution? Believe me, creation is not yet finished. With proper care and under favorable conditions, the cow is likely to adjust herself to the increased demands made upon her system. There are many ways in which this can be done; not least of all is that of increasing the number of producing cells, which is what she actually has done and is doing under domestication.

THE INHERITANCE OF LEFT-HANDEDNESS

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There is a widespread popular belief that left-handedness is hereditary. When left-handedness appears among a childship,[1] the parents concerned at once trace it to some direct or collateral ancestor. If the known ancestry contains no individual to whom influence may be ascribed, there is occasioned the greatest wonderment. On the other hand, biologists do not seem to believe in a hereditary bias to left-handedness. Otherwise, it would seem, some attempt had long been made to state its principle of "transmission." Gould (1908), who has given much study to the clinical aspects of left-handedness as supposedly connected with unilateral eye-defect, states very emphatically that left-handedness is not hereditary, and takes gratuitous occasion to speak slightingly of "Mendelism."

To the writer there remains no doubt that left-handedness is hereditary (in the sense that offspring resemble ancestors in this characteristic), and that the condition reappears in successive generations. Leading to this opinion is the fact that in his own ancestry, both direct and collateral, as far as he can determine, there is nowhere left-handedness. Moreover, he has the assurance of a number of friends, taking an intelligent interest in the matter, that the same is true of themselves and their ascendants. Furthermore, in a number of cases known to the writer, the condition of left-handedness has reappeared three or even four times (one case) in as many successive generations.

The fact of its reappearance in certain stocks seems well established. What is obscure, and bids fair to so remain for some time to come, due

[1] The word "childship" is used in the sense defined by E. Stainer ("The Hereditary Transmission of Defects in Man." Dissertation. Oxford University Press, 1910) to designate "the family of children resulting from a marriage," p. 5.

mainly, I believe, to the small number of individuals in any one affected family, is the rule or principle governing the reappearance. Nevertheless, the following facts drawn from a study of 78 lineages in which left-handedness is noted, representing the result of a canvas of nearly 3,000 individuals, may suggest a probable state of affairs and perhaps serve as a beginning to an investigation that further study and more data may very appreciably extend and enhance.

CAUSE OF LEFT-HANDEDNESS

This study is only incidentally concerned with the etiology of left-handedness. The purpose of this research is primarily to note the occurrence of this particular variation among the members of certain families and to formulate, if possible, some principle or principles apparently governing its reappearance and distribution in certain lineages. The work aims, moreover, to make a contribution to the general subject of heredity. The characteristic of left-handedness must have a cause, but whatever this may be in terms of structure is of only secondary interest in this connection.

However, it may serve to set the problem a little more clearly, to record that inveterate left-handedness is invariably associated with general left-sidedness, *i.e.*, left-leggedness, left-eyedness, etc. (see Sibley to the contrary); and that the cerebral localization of this function (*i.e.*, movement of left hand) in the sinistro-manual is in the right cerebral hemisphere (next Broca's center in the third frontal convolution), the reverse condition obtaining in the dextro-manual. The proof of these facts was from the field of pathology and was summarized, and confirmed by personal experience, by Wilson in his valuable and interesting pioneer work in 1891. In this same book are discussed, in a most scholarly way, many theories, mostly mechanical, *e.g.*, transposition of viscera, center of gravity theory, etc., formerly held, all of which are satisfactorily disposed of as very manifestly erroneous or only partially explanatory. Wilson attributes left-handedness proximately to a greater development (preponderant size and weight) of the right cerebral hemisphere and cites authorities (both pro and con) and gives his own evidence from a peculiarly favorable case.

The more recent theory of Gould (1908) to the effect that right-handedness follows the generally more perfect development of the right eye, advanced to supplant all former theories, has been shown by Stevens (1908) to be of doubtful verity. It seems more nearly correct to think of right-eyedness as a condition concomitant with

right-handedness and both dependent upon the same or related cause. At any rate the offered proof is not compelling that they are related as cause and effect. And until Gould shall have frankly reckoned with, and satisfactorily met, Stevens's criticism his "theory" remains largely a speculation.

A careful weighing of available evidence regarding the cause of left-handedness (as furnished more particularly by Hyrtl, Wilson, Gould, and Lombroso) indicates a better developed right cerebral hemisphere. This would seem to depend upon a better nutrition and ultimately upon a better blood supply. The final cause—the factor determining the anatomical variation in the condition of the fœtal blood supply—remains an outstanding riddle. The matter which chiefly concerns us here is to determine in what way or ways this factor (or factors) expresses itself. The fact of the existence of a large class of so-called ambidexters of various degrees, as also of degrees of right-handedness and left-handedness, renders more plausible the assumption that these conditions ultimately depend upon various degrees of variations in the more usual vascular arrangement in the cerebral hemispheres.

HISTORICAL

Probably the earliest data regarding left-handedness are those recorded in Judges 20:16 respecting the tribe of Benjamin. Here there were 700 left-handed slingers in a military population of 26,700. This proportion accords very well with the recent statement of Hyrtl to the effect that among the civilized races of Europe left-handedness prevails in the ratio of 2 per cent (Gould puts it at 6 per cent for the United States). Regarding the Benjamites, however, one must remember that the Bible narrative gives no clue as to whether the left-handed slingers were by nature or by training (as a strategic measure) sinistro-manual in war.

In volume 1, book 4, chapter 5 of Sir Thomas Browne's "Vulgar Errors" (H. G. Bohn, Covent Garden, 1836) is given an interesting, more or less absurd, discussion "Of the Right and Left Hand" with a consideration of earlier theories to account for right-handedness, more particularly those of Aristotle (use), Scaliger ("crassitude, and plenitude of blood") and Caelius Rhodiginus (sinistral location of liver). In a footnote is given Signor Zecchinelli's very plausible explanation for the general preference of the right hand, quoted from "Brande's Journal," viz: "For it must have been observed, that when the left arm is long used, or violently exercised, the left

side also of the chest is put more or less in motion, and a consequent and corresponding obstacle produced not only to the free emission of blood from the breast, but also to its progress through the aorta and its ramifications." (I am indebted to Dr. Bennett Wood Green for this early reference.)

Prof. Hyrtl of Vienna has noted a correspondence between the ratio of left-handed persons and the occurrence of certain deviations from the normal arrangement of the blood vessels. "It happens," he says, "in the proportion of about two in a hundred cases, that the left subclavian artery has its origin *before* the right and in these cases left-handedness exists as it also often actually does in the case of complete transposition of the internal organs; and it is found that the proportion of left-handed and right-handed persons is also about 2 to 100" (quoted from Wilson). Wilson points out, however, that the evidence that in other cases an anomalous blood supply (transposition) has been unaccompanied by left-handedness shows that "it is no necessary source of deviation from normal action." Wilson calls attention to four cases referred to by Dr. Pye-Smith (Guy's Hospital, London) where the subject of abnormal disposition of the viscera had been right-handed. Four additional non-conforming cases are cited by Wilson.

Dr. Pye-Smith says: "The opinion that some difference between the two sides of the brain has to do with our preference for the right hand over the left may, perhaps, be supported by two very interesting cases of aphasia occurring in left-handed persons, recorded by Dr. Hughlings Jackson and Dr. John Ogle. In both these patients there was paralysis of the *left* side; so that it seems likely that in these two left-handed people the right half of the brain had the function if not the structure which ordinarily belongs to the left." A third case checked at autopsy is reported by Wilson. Case No. 17 of my own material has a similar history, as will be described below.

Wilson believes that left-handedness is due to an exceptional development of the right hemisphere of the brain; "that advantage accrues to all from cultivation of dexterity in both hands; that the right hand is given preference naturally or instinctively by some . . . in a smaller number left-handedness is formed by an equally strong impulse . . . but in the great majority right-handedness is largely the result of education." Garman, in reviewing this book in "The Nation," suggests that the greater development of the left hemisphere may be due to the greater use of the right arm, i. e., cause and consequence are thought of in the reverse order by Wilson.

Furthermore, Garman insists that "it is still an open question whether an organ less developed is more liable to disease," as Wilson urges in support of his idea of the value of the training for ambidexterity. The final settlement of the question regarding the greater development of the right and left cerebral hemispheres in left- and right-handed individuals respectively awaits careful study and measurement of a large series of infants' brains.

Gould, with much reason it would seem, ridicules the "ambidexterity silliness" as provocative of much misery. Common sense alone dictates that where one hemisphere is apparently well capable of controlling a certain range of physical and mental activities, it were a waste of time to cultivate a bilateral control (a possibility often realized when a member of one side of the body is incapacitated). Moreover, when a child at school gives evidence of stronger preferment for using the left hand, it were criminal to handicap and abuse that child by forcing it to use the right hand. His theory, however, that right-handedness is due to a more efficient right eye disregards contradictory neurological facts as pointed out by Stevens.

Lombroso (1903) studied left-handedness from the viewpoint of mental pathology and psychiatry. He calls attention to a widespread belief in the mental and moral crookedness of a left-handed man. His studies led him to the opinion that the left-handed are more agile, and "ordinarily found among women, children, and savages and they were more numerous in past ages than they are now." Among 1,029 operatives and soldiers 4 per cent were left-handed. The ratio among women operatives ranges from 5 per cent to 8 per cent. "Among lunatics the proportion is not much different." Among male criminals 13 per cent are left-handed; and among female criminals 22 per cent. 33 per cent of swindlers are said to be left-handed. The ratio of left-handedness among murderers and ravishers is given as 9 to 10 per cent.

Lombroso studied 44 heads of criminals in the museum at Turin and found the right lobe better developed in 41 per cent; the left lobe in 20 per cent. Ordinarily, Lombroso states, the left lobe takes precedence. "Receiving the blood from the heart more directly and in greater quantities than the right, it is the first to develop from the embryo, works more, and is the more voluminous of the two, the right only serving, one may say, as a help or reinforcement to the other" (p. 442).

Audenino (1907) expresses his opinion that recent researches have shown that left-handedness is more frequent among criminals,

immoral individuals, prostitutes and epileptics, and that children during the first month (Baldwin) are for the most part ambidexterous. Further, that left-handedness is a degenerate characteristic, an atavistic phenomenon (Lombroso; Louis Agassiz also held this opinion). Lombroso says: "But then, what significance has ambidexterity? According to Brinton, the anthropoids are ambidextrous; according to Le Bon ambidexterity is frequent among savages, idiots, and infants. Ambidexterity is likewise frequent among criminals and epileptics; also, it seems to me that many of those which appear left-handed (and left-handed on the dynamometer also) are really ambidextrous; and that ambidexterity, more than left-handedness, represents an atavistic character" (p. 26). He admits that it is not easy to tell in many cases whether one is dealing with a left-handed or a right-handed person. Tested with the dynamometer on successive days subjects (i. e., students, etc.) gave results indicating ambidexterity, right-handedness or left-handedness. This was equally true of individuals who said they were left-handed.

Lattes (1907) notes that cerebral asymmetry is greater in delinquents, children, idiots, and negroes than in normals.

He draws the following conclusions from his investigations:

1. Right-handedness is connected with morphological and functional asymmetry of the brain.

2. There are two kinds of left-handedness:

   (a) Atavistic (constitutional), due to an inversion of normal cerebral asymmetry.

   (b) Pathologic left-handedness (manifested after a left cerebral lesion), which left-handedness is what predominates in epileptics and delinquents.

Touching the matter of hereditary left-handedness the literature is very meager. Wilson states that M. Ribot in his "Heredity" wrote: "There are families in which the special use of the left hand is hereditary. Girou mentions a family in which the father, the children and most of the grandchildren were left-handed. In an instance communicated to Wilson both parents of a gentleman in Shropshire were left-handed. His mother accordingly watched his early manifestations of the same tendency, and employed every available means to counteract it. The left hand was bound up and tied behind him. But all efforts to suppress the impulse were in vain." Weber (1904) argues that the anthropoids, primitive man and the young child (before eight months) are ambidextrous. He suggests that the almost universal choice of the right hand by the growing

child is the expression of a hereditary bias acquired by man during racial development.

Merkel (1904) comes to the conclusion that right-handedness and left-handedness rest upon an heritable originally better organization of the left and right cerebral hemispheres respectively.

On the other hand, Kellogg (1898) claims that right-handedness is due to training and habit. He thinks, moreover, that great benefit accrues to the ambidextrous individual, and urges that training be directed to this end. He cites Brown-Sequard as an eminent scientific advocate of this view. He notes also, in support of his contention, that Leonardo da Vinci and Michael Angelo were ambidextrous. Galippe (1887) and Broca (1888)—cited by Bardeleben—still earlier expressed belief in the educational origin of right-handedness.

As a result of a large series of experiments on his own child from the sixth to her tenth month, Prof. Baldwin (1905) concludes "that dextrality is due to a difference in development in the two hemispheres of the brain, that these differences are *hereditary* [italics my own] and that they show themselves toward the end of the first year" (p. 75). Continuing he says: "It is a singular circumstance that right hand and speech are controlled by the same hemisphere of the brain from contiguous areas. It would explain this—and at the same time it seems probable from other considerations—if we found that the right hand was first used for expression before speech; and that speech has arisen from the setting aside for further development, of the area in the brain first used for the right hand" (p. 76).

In an extensive article of 72 pages, Prof. Karl von Bardeleben (1909) reviews the whole subject of bilateral asymmetry in man and higher animals. More than half of the paper is devoted to a critical comparison and evaluation of various theories advanced to explain unilateral dextrality. The appended bibliography of 186 works is possibly the most complete on the general subject. Bardeleben expresses belief in the hereditary nature of left-handedness (likewise right-handedness), but whether this inborn tendency be localized in skeleton or muscles of arm or in the brain he leaves undecided. Nor does he find any clue as to its phylogenetic origin. He concludes that there is as yet no solution of the phenomenon of right-handedness, adding that "no solution is better than one or several that are erroneous" (p. 56).

He also thinks that "man could only gain if, instead of having only one well-developed hemisphere, he had two, which could be employed not only in case of need, but in the varied employments of daily life"

(p. 43). He opposes the position that right-handedness is due to a better developed left cerebral hemisphere, as supported more especially by Merkel, on the ground that "neurological evidence forces the conclusion that right-handedness is and was the primary condition, the higher organization of the left hemisphere was and is the consequence" (p. 48).

It must be pointed out, however, that the "neurological evidence" here referred to (*i. e.*, use of end-organ reacts developmentally on its brain center) has meaning in this connection only in the event that it can be proved that a primary better blood supply to one or the other hemisphere does not produce a correspondingly greater development. In opposition to the theory as developed by Lueddeckens (1887), that dextrality is due to asymmetry of the large arteries, he argues that also the better blood supply of the left hemisphere is consequence (not cause) of right-handedness (p. 28).

The main support for this opposition seems to be derived from the fact that cases of situs inversus have been recorded coincident with a condition of right-handedness. It must be emphasized, however, that the theory does not necessarily imply complete situs inversus. The blood vascular system is subject to a wide range of variations. A very slight alteration in the more normal arrangement in early embryonic or fœtal life may be sufficient to supply the better nutrition from which a better developed right hemisphere may originate, determining a future left-handed individual.[2]

Bardeleben also introduces an element of confusion in the whole discussion when he speaks of anthropoids as preponderatingly right-

[2] This idea is based upon the anatomical relations of the arteries (internal carotids) carrying the blood to the developing brain. The arrangement, as concerns the arteries involved (internal and external carotids and subclavian), is relatively permanent after the earliest embryonic stages (ca. 5 weeks). Examination of the arrangement of the aortic branches of a 10 mm. human embryo reveals the fact that the most direct course of the blood passing from the left ventricle is up the innominate artery. However, before reaching the internal carotid, the main stream is shunted off into the right subclavian artery. Moreover, the most direct course for the remainder of a particular stream is up the external carotid. It follows, then, that the internal carotid receives a relatively small portion of the blood directed towards the right side. On the contrary, the most direct course for the blood passing to the left side is up the left common carotid, and into the left internal carotid, which thus receives the main stream. As compared, then, with the right, the left internal carotid receives during embryonic and fœtal life a larger amount of blood. Moreover, as compared with the right, the left subclavian artery receives a considerably smaller amount of blood. Thus the combination of vascular conditions favoring the better development of right arm and left cerebral hemisphere may conspire together to produce right-handedness; a reversal or disturbance of such conditions, left-handedness—or the various degrees of ambidexterity. Stronger right arm and better developed left cerebral hemisphere may possibly not be in the relationship to each other of cause and effect (Bardeleben) or the reverse (Wilson), but may both be due to the normal anatomical arrangement of the main branches of the arch of the aorta, determining that these two structures on opposite sides of the body, as compared with their respective comites, shall be better nourished; hence both may really be the combined proximate cause of right-handedness.

handed on the basis of greater development (size and weight) of the right fore-limb. Right-handedness (in the restricted sense in which the term is ordinarily employed) signifies essentially greater dexterity with that hand, or a predominating tendency to use the right hand in executions requiring skill and in delicate manipulations. It seems necessary to make a distinction between functional (deftness) and structural (size and weight) bilateral asymmetry (cf. Weber).

Bardeleben thinks finally that there is no satisfactory anatomical explanation of right-handedness yet forthcoming. "We know as little why we are right-handed, and why a certain proportion of mankind are left-handed, as we are able to state what 'right' and 'left' are, or why there are dextro-rotary and levo-rotary solutions of sugar and other substances, or why some of the planets revolve around the sun and on their own axes from right to left and others in the opposite direction" (p. 36).

The report that certain animals (*e. g.*, lion, camel, parrot, monkey, etc.) are predominantly right or left-handed is probably without foundation in fact. The apparent left-handedness (left-footedness) of parrots, so frequently cited, is a simple matter of imitation and convenience as demonstrated by Dr. David Starr Jordan. Ordinarily parrots are approached in feeding, etc., with the right hand. They most conveniently receive with the left foot. When the left hand is employed in the test, the parrot invariably responds with the right foot.

The several points appearing in this brief survey of the literature upon which my own results may be presumed to bear are (a) left-handedness is localized in the right cerebral hemisphere (Hyrtl, Wilson, Cunningham, Merkel, Baldwin); (b) left-handedness is hereditary (Wilson, Merkel, Weber, Bardeleben; Gould expresses an unqualified denial; also Kellogg); (c) left-handedness occurs more frequently in females than in males (Weber); (d) left-handedness is more frequent among delinquents (Lombroso, Audenino, Lattes); (e) left-handedness is more frequent among negroes (Lattes). The heredity character of left-handedness is the point especially sought to establish in the material and arguments presented below.

GUIDING HYPOTHESES

As my study of left-handed families progressed, the following hypotheses, conforming in general to a Mendelian interpretation, suggested themselves:

(a) Left-handedness (L) and right-handedness (R) are dependent upon a varying anatomical condition; secondarily on the condition of the blood supply (on evidence of the above-named investigators).
(b) R = usual condition, therefore tends to be dominant.
(c) L = variant condition, therefore tends to be recessive.
(d) Ambidexterity (A) = condition of imperfect dominant or "blend."
(e) $R \times L = RL$ = right-handedness or ambidexterity.
(f) $RL \times RL = RR + 2RL + LL = 3R + L$.
(g) $2RL \times LL = 2RL + 2LL$.
(h) $RL \times RR = 2RL + 2RR$.

The final effort was to attempt an interpretation of the 22 family histories respecting which the data were more complete and reliable, in terms of the Mendelian formulæ d to g. It must be admitted at once that the formulæ fit only selected cases, and in all cases, of course, the character of the parental germ cells can only be inferred. Nonconformity may very likely be due to comparative scarcity of data. There is significance in the fact, I believe, that none of the collected data directly contradict these formulæ.

MATERIAL

The material for this study represents the results of a canvass of the university students (700) and the pupils of the public school (white 1,394, colored 668). The following 24 schemes give the facts regarding the most interesting families. These pedigrees are of university students, of pupils of the white public school, and of the pupils of the colored public school.[3]

DESCRIPTION OF SOME OF THE FAMILIES

Fig. 1. This pedigree shows transmission by a carrier male, and gives a four-generation history of left-handedness.

[3] The following symbols are used in the heredity charts: male, right-handed; female, right-handed; male, left-handed; female, left-handed; male, ambidextrous; female, ambidextrous; sex unknown, right handed; sex unknown, left-handed

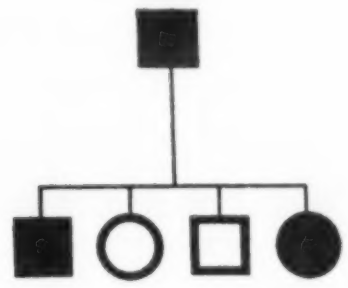

Fig. 2. This childship is interesting mainly for the reason that it shows direct transmission to half the individuals and both the affected and unaffected are equally divided as to sex.

Continuation in next number.

A SYSTEM OF NUMBERING INDIVIDUALS OF THE HUMAN FAMILY

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To one who has had to do with pedigreed live stock where each animal is given in addition to its name a distinctive number for the purpose of exact identification and ready reference, the question naturally occurs whether the same idea of adding a number to the name could not with great advantage be followed in the registering of human births; and for the purpose of exciting a discussion on the subject the following crude scheme is outlined and some of its points considered.

If numbers were added to the name of the individual and the present system of state registers made to center in a national register we would have for the human family of the nation the same accurate and ready genealogical information as is now provided in the case of the better classes of our domestic animals.

The present system of registering by names which are common to numbers of different persons furnishes so little identification as to be almost useless, whilst the amount of work involved is nearly or perhaps quite as great as would be required for the immeasurably more exact and useful system proposed.

At present the registration of births, deaths, and marriages is, in Canada, a provincial institution, under which the local registrar sends in his registrations periodically to the capital of his province. In the United States I presume registration is at present a state institution.

According to the scheme we are proposing it would be a national institution and the local registrars would send in their registrations periodically (say monthly) to the national capital, where numbers would be assigned, the registrations compiled, and copies returned to the local registrars; there would then be two sources of information, namely, the office of the local registrar in each municipality and the office at the national capital. The numbers thus assigned monthly would in a general way be chronologically consecutive with respect to the dates of the births; and this would be convenient but not at all essential.

Assigning numbers to all future births would immediately bring all the coming generation under the system, and all the important part of the present generation would be brought in also, by assigning numbers to the parents at the same time as assigning numbers to the births. Immigrants could be assigned numbers in the same way as births, so soon as they become settled in their new homes; or they could be permitted to remain until they presented births for registration.

A number is itself an index to its own location in every consecutive list; and the system of numbering once established, it is probable that statistical lists intended for reference would then usually or always be made in the order of consecutive numbers, with or without the addition of the names, as the case might call for.

Given any individual's number, the father and mother could be immediately ascertained by reference to the national records, and the exact pedigree established as far back as the records extended.

The numbers which go to this pedigree, having been written down consecutively, could be readily detected in any consecutive list it was desired to search: for instance in the army list, navy list, list of legislators, judges, professional and business men in the various professions and lines of business which keep registers of their members; in the registers of asylums, prisons, tuberculosis and cancer hospitals, etc. Such lists are kept at present but are compiled with names alone, which, as said before, furnish so little identification that one has to have outside information in order to know whether the name when it occurs refers to the individual in question or not. When compiled according to consecutive numbers, these lists could be readily searched, and would furnish exact information.

It is needless to point out the great advantage to the study of eugenics. The way would be opened to the compilation of a great

variety of useful statistics helpful both to those studying eugenics and to those desirous of putting into practice the precepts it teaches.

By his identification number the individual's history could be readily and accurately traced through his school, college, university, military, naval, professional, or business career; assuming that all institutions were then to maintain numerical lists as most of them do now alphabetical lists. One indirect advantage would perhaps be the stimulus to the individual, seeing that his identity was so thoroughly established for all time to come, to make as good a record for himself and his family as he could accomplish; and to have his number appear in as many honorable lists and in as few discreditable lists as possible, knowing that his number wherever it might appear would definitely point to him. He would probably display more care on account of the number which was his exclusive property than on account of the name which he shared in common not only with relatives but probably with many others in no way "connected."

Other points worth considering are: easy identification in the case of legal disputes lost heirs, etc., and the question of advantage to the police. This leads to the consideration of some scheme by which all would be required to furnish their number upon demand; with a penalty for giving a fraudulent number; some further scheme for detecting fraud; and some system providing for the identification of those too ignorant to be entrusted with the keeping of a number. Fraud would have to be contended with then, as now, but fraud in the matter of identity would be more easily detected in the case of numbers, or rather numbers added to names, than in the case of names alone; for it is not proposed to do away with names but to give numbers in addition to names.

Although this scheme for bringing in the whole population would be more complete, more useful, and probably the more easily worked, I would suggest to those who think it too extreme, the consideration of some less comprehensive scheme, say one that might be voluntary; for the usefulness of such registration as is suggested would not be destroyed by reason of its circumscribed adoption. On the contrary its usefulness would be commensurate with the extent of its adoption.

If a bureau were established at the national capital for the purpose of receiving voluntary registrations and of promulgating the scheme, it is probable that national registration would shortly become honorable and sought after. The better classes would feel it an advantage to escape from the ranks of the "unrecorded", to join those who would have a place in the national records and history of their coun-

try; and this would be from the beginning a gain of constantly increasing value.

The less comprehensive scheme, however, does not appear to me as being either so good or so workable as the scheme to bring in the whole population.

There is perhaps no more important subject than that of improving the human race in respect to a sound mind in a sound body, and this subject is being largely discussed at the present time. After discussion should come action; and intelligent action must be founded on reliable information. It appears to me that the system of registration proposed will do more than anything else towards accumulating in the course of time a large fund of the very information desired.

Whatever use future generations may see fit to make of such information, we can at least perform some share of our duty in the great work by endeavoring to accumulate it.

Whilst numbers are so superior to names for the purpose of identification and as an index to statistical compilations, names are no less important, and it might be well to give some consideration to improving our system of nomenclature.

At present, as it is customary for children to be called by the surname of the father, the mother's name is completely dropped out of use, and frequently out of recollection. Our names in consequence only indicate one-half of our immediate ancestry.

A suggestion I would offer for discussion is that our surname should be a compound of the last name of our father preceded by the last maiden name of our mother.

This compound name might be established and the system maintained by requiring it to be written in full in every case where a legal signature is demanded.

The last name of the compound would be adhered to from generation to generation as at present, but the first name of the compound would change in each generation to correspond with the last maiden name of the mother; thus, supposing a Mr. Smith married a Miss Jones, his children would be known as Jones-Smith and the children of his son, say Tom Jones-Smith, who married Miss Casy-Brown would be known as Brown-Smith.

In some of our rural municipalities settled in the early days by a few families who have multiplied and filled the neighborhood, intermarriage between relatives is frequent and is sometimes continued to an undesirable extent; and this is often done without the evil being

recognized by the contracting parties, or their parents, from the fact that there is nothing in the names to show the connection when it comes in on the female side of the pedigree. A McKay may marry a Casy, and on the face of it the union show no fault; but it might be a Casy-McKay marrying a McKay-Casy and under this system of naming a relationship would at once be suggested. If McKay were to marry his cousin McKay, as is not infrequent, and again McKay junior the son of these cousins were to marry in turn his cousin McKay, this last marriage, although much more objectionable than the first, would appear to be about the same; but under the system of naming suggested the first would read, say, Casy-McKay to Jones-McKay, while in the latter case it would read McKay-McKay to say Brown-McKay, or possibly McKay-McKay to McKay-McKay, which would at once draw attention to the likelihood of undesirable consanguinity.

We frequently see now the maiden name of the mother given as a middle name to one of the family, but we seldom see it given to all the children. The question suggested for discussion is, whether it is worth trying to make this method of naming the rule instead of the exception; for it will no doubt be granted that some system that will indicate the mother as well as the father is desirable.

A summary of the suggestions amounts to a number for the purpose of exact identification, etc. a Christian name for familiar use, and a compound surname indicating both the parents.

REPORT OF THE COMMITTEE ON HEREDITY OF EPILEPSY.

WILLIAM N. BULLARD, *Chairman.* EVERETT FLOOD, *Secretary.*
E. E. SOUTHARD. J. MUNSON.

The Committee on Heredity of Epilepsy was notified of its formation in the summer of 1910 and held a meeting very promptly afterward. The situation was discussed and circulars were sent out to those persons who were most competent to give us the information desired.

The four questions asked and the replies received were as follows:

1. Are you acquainted with any instance where a non-epileptic child has come from two epileptic parents? Have these parents also epileptic offspring? Eleven replied in the negative and three in the affirmative.

2. Please give cases you have known where an offspring with one epileptic parent has been free from epilepsy. Facts about children in the family, etc. Six replied in the negative and seven in the affirmative.

3. Can you give one or more instances where an epileptic person can be shown to have had no epileptic inheritance (epileptic, insane, inebriate or allied condition in blood relation as parents, brothers and sisters, grandparents, uncles, aunts, first or second cousins, great-uncles, great-aunts, children? Nine replied in the negative and eleven in the affirmative.

4. Can you cite the case of any epileptic person whose ancestry can be traced with almost absolute accuracy for three generations? Preferably cite cases with two or more epileptics in one family. Eleven replied in the negative and five in the affirmative.

Another consultation of the committee was held and it was thought advisable to try to get more explicit statements from certain ones who answered the questions. This inquiry is now under way.

The results of the work of our field worker have been very satisfactory. It appears that we shall in time be able to trace out certain families in which there is a hereditary tendency to epilepsy.

This work will be carried on and full detailed reports given in due time.

THE KARAKUL BREED OF SHEEP

C. C. YOUNG

Goodnight, Texas

The Arabi or Karakul sheep has its origin in the Khanate of Bokhara, Central Asia, and belongs to the long-wool family from which all broadtail varieties descend. For centuries Arabi bucks have been smuggled into Afghanistan, Persia, Turkestan, China, Palestine, Syria, Asia Minor and Egypt and because of the ignorance of the natives, who seem to have no conception of proper breeding have been crossed with native sheep of the long-wool, short-wool and hairy classes, which in all of those countries belong to the most inferior type of domestic sheep imaginable. Were it not for the fact that the Arabi strain was from time to time injected into the native sheep of the above-named countries, their sheep industry to-day would amount to absolutely nothing. As the Arabi is essentially a desert animal, and able to withstand any amount of hardship, evi-

dently not minding the intense heat in the summer nor the severe cold in the winter, often going for days without food and water, it can readily be seen why the people living in the arid countries of Central Asia found it advantageous to cross their native sheep with the Arabi, which is the heaviest sheep known. The barren semi-mountainous country of Bokhara in which the Arabi thrives certainly does not show much evidence of grass, except here and there

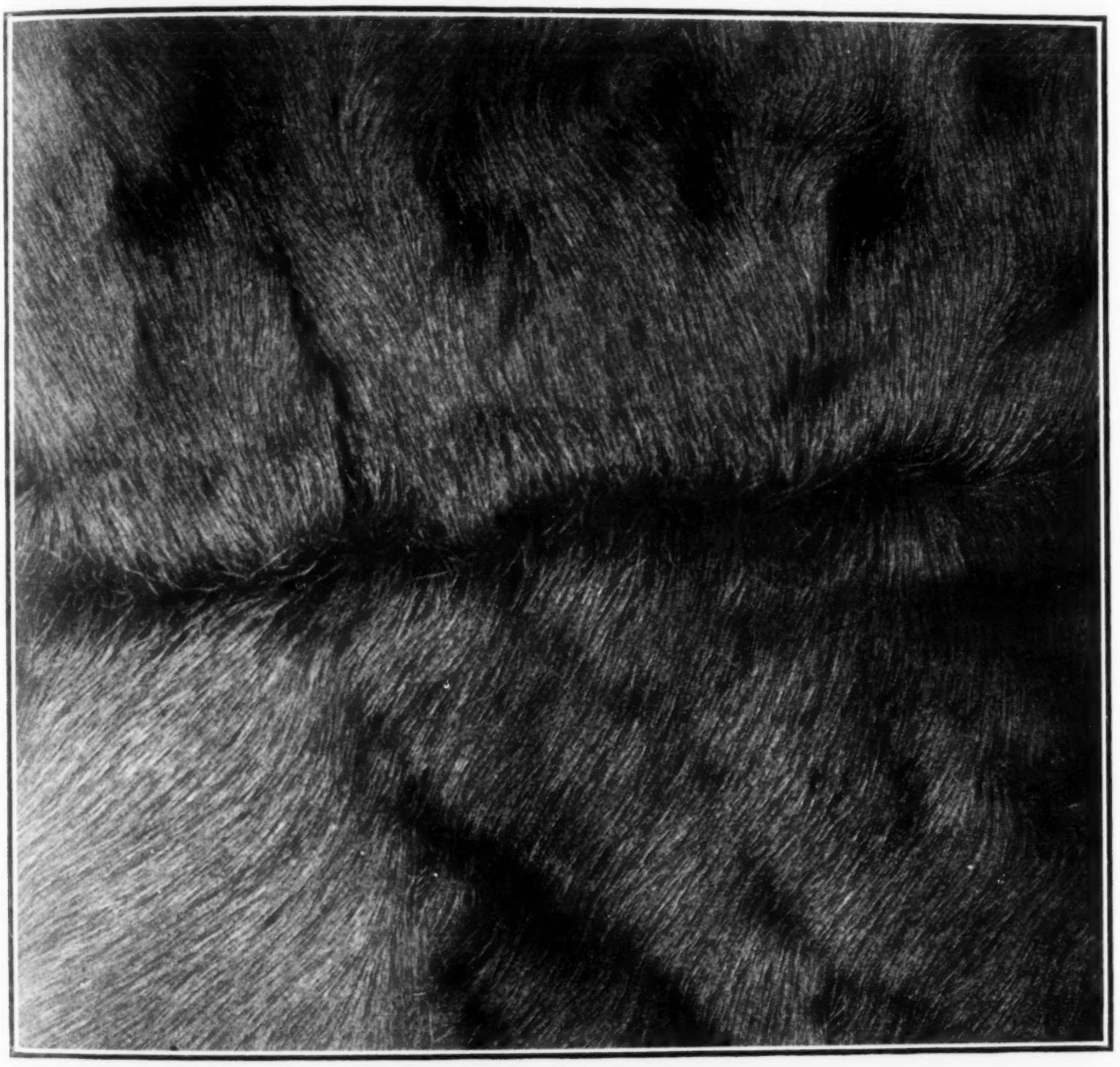


FIG. 1. UNBORN HALF-BREED KARAKUL SHROPSHIRE.
Obtained before fur shows figures. Object was to obtain unborn Karakul-Shropshire velvet with figures.

in the small valleys, and nature has made it possible for this animal to store in a short time large quantities of fat in its immense tail, weighing from 25 to 50 pounds, upon which it draws for sustenance when necessity demands it, and these properties are in a large measure transmitted to the offspring resulting from crossing the Arabi with the native sheep.

One has to eat the mutton of the Arabi but once to realize that it has absolutely no sheepy taste, but possesses a delicious and very appetizing flavor, that has made "shashlik" a famous dish among the epicures of Europe and Asia. When, therefore, an Asiatic possesses a flock of inferior common sheep with the musk-like flavor of the Merino sheep or the goat family, and seeks to get an increase in weight and a hardiness capable of withstanding the intensely cold winters of a country like, say, Afghanistan, he naturally turns to the Arabi family, knowing well that with even a 25 per cent of Karakul injection this musklike flavor can be overcome.

The Arabi lamb before birth, or a few days after, is a most intensely black-pigmented animal. It has a high luster, giving it the appearance of the richest of black figured velvet, with tight curls more or less evenly distributed. The pigment is practically not affected by the rays of the sunlight, which is, however, not the case with the commercial Arabi fur obtained by crossing the Karakul with common sheep, of which it is absolutely necessary to dye the skins. It is this fact that made Leipzig and its immense dyeing industry famous.

There are two classes of Arabis, the small and the large variety. In my opinion the small Arabi is the original wild, broadtailed sheep, from which all other broadtail varieties originate. They are always born black, and later become gray. The head is narrow and the face elongated; head-line curved with small ears. The feet are thin, as is the case with all wild animals of the ovine class. The tail is not very long, but broad, and triangular in shape, and they are all horned, with whitish spots on the head, tail, feet, and both sides. This sheep is said never to have existed anywhere but in the mountainous section of Bokhara. The tail not being as large as in the large Arabi would explain why these animals have been able to mate without assistance. The animal certainly has the appearance of a wild sheep and in every way resembles it. They are probably a little heavier than the American Shropshire. The large Arabi has a massive head, short face, nose-line bent, ears pendulous and quite large, with thick strong feet, especially the hind legs, with an immense S-shaped tail reaching to the ground, and when they are at all fat the tail drags, and in exceptional cases it has to be supported, which is done by placing it on a two-wheeled cart. Like the small variety, they have stiff hair on the front head and lower portion of all four extremities, but are not horned, nor have they the white spots mentioned of the other variety. Quite often they have auburn lambs. The Tartar

authorities think that this class resulted from crossing the small variety with some big, long-wool short-tailed white or auburn sheep of Bokhara. If that is the case I cannot understand why there is such a difference in the size and shape of the tail. These two classes have been crossed, and in many instances it is almost impossible to select typical specimens representing either class.

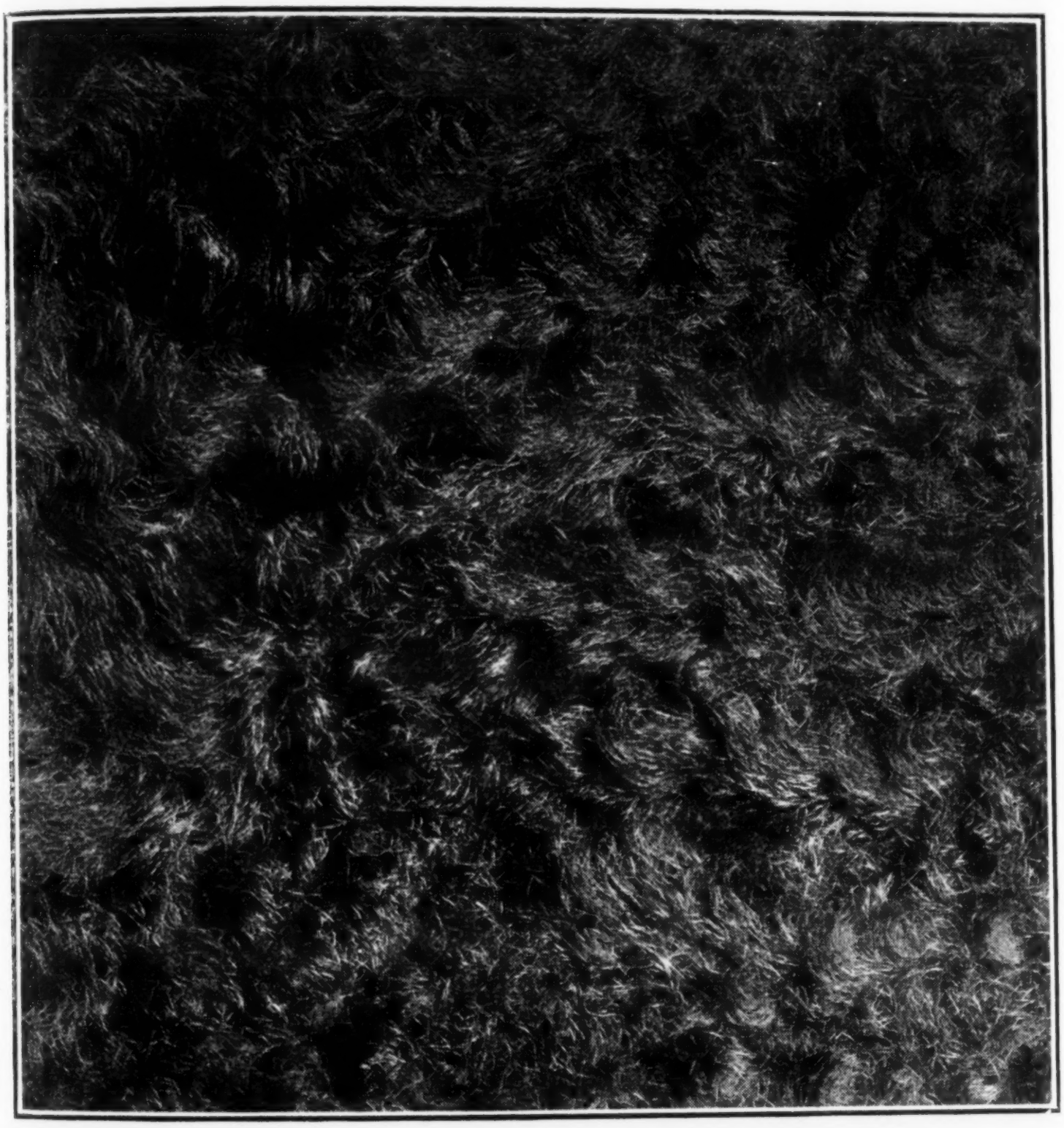


FIG. 2. HALF-BREED KARAKUL-MERINO.
A practical fur, but lacking in luster; known in Russia as peasant fur.

The fifteen head which I brought to this country belonged to both classes, and some of them no doubt are crosses between the two, notwithstanding the fact that we have tried hard to avoid such a selection. I have, however, only one ram which comes anywhere near having the enormous tail with which many of the large variety

are encumbered. It is very difficult to drive those with an immense tail and I was afraid of losing them on account of the long trip.

The fur of the smaller Arabi is superior to the other kind, which again strengthens my belief that the small Karakul is the original wild broadtail above mentioned.

On account of the small number of full-blood Arabis (it is estimated that there are not over 5,000 full-blood Arabis in Bokhara) very few of them are ever killed and what few Arabi skins are permitted to be exported seldom ever come into the possession of anyone except the richest classes of the nobility of Asia and Europe; those less fortunate have to content themselves with the commercial furs, such as Persian lamb, Astrakhan, Krimmer, and Afghan (the last is known in America as Karakul). The Afghanistans deserve the credit for producing the first and the best commercial Arabi fur and I am completely at a loss to understand why Persia is getting the credit. It is probably due to the fact that the crafty Persians have for years bought up the best products in Afghanistan and after making a good profit have disposed of them to the European merchants at Tashkend, whence they go to Nishni Novgorod, the old capital of the former Russian republic of Novgorod, whose commerce extended into Turkey, Greece, Persia, and even India at a time when the Teutons and Anglo-Saxons were still barbarians.

The commercial Arabi fur known as Persian lamb, Astrakhan, Krimmer, and Afghan is the result of breeding the Karakul to certain species of common native sheep of Central Asia. The natives have learned from many years of experience that producing sheep for fur purposes gives them twice or thrice the profit that they could derive from wool and mutton only. As the lambs are killed the first few days after birth, the mother ewes are permitted to lamb twice yearly and as the skins bring anywhere from $4 to $10 each, it is easy to calculate the breeding value of an Arabi buck. For about thirty days after the lamb has been killed the mother ewes are milked and a delicious cheese is produced, known as "brinza," which brings from 20 to 30 cents a pound, and this alone pays the expenses incidental to the breeding of the sheep, where labor is as cheap as is the case in Bokhara. The meat of the lambs is also an item worthy of consideration. We have yet to learn in this country that chops from very young lambs are very good indeed to eat, especially when properly broiled and served *en brochette.*

An excellent fur is obtained by crossing a half or three-quarter-bred Karakul ram with the long-wooled sheep known as "Roman-

ovskaja," resembling the black-faced Highland. In the last few years Russia has produced a large quantity of this class of fur, which finds its way to Nishni Novgorod, and there is sold for Persian lamb, with which it compares very favorably. Russians are beginning to realize that the English breeds, as the Lincolnshire, Leicester, Cotswold, and especially the Shropshire, which possess a luster almost

FIG. 3. A GRAY FUR 75 PER CENT MERINO-LONGHAIR AND 25 PER CENT KARAKUL.

equal to the Angora goat, give a fur far superior to anything that Asia can produce. Experiments conducted by such well-known breeders as Goodnight, Albright, and others prove conclusively that we can excel in beauty and luster the imported Persian lambskins that are sold in the United States. The writer's experience is limited to the Lincolns, Shropshires, and Merinos, and those interested may exam-

ine the skins produced on my ranch in northwest Texas. The Karakul-Merino cross possesses sufficient luster to be considered salable and could be sold by farmers for $2 or $3 a skin, which is not a bad price for a three-day-old lamb, especially when one considers that

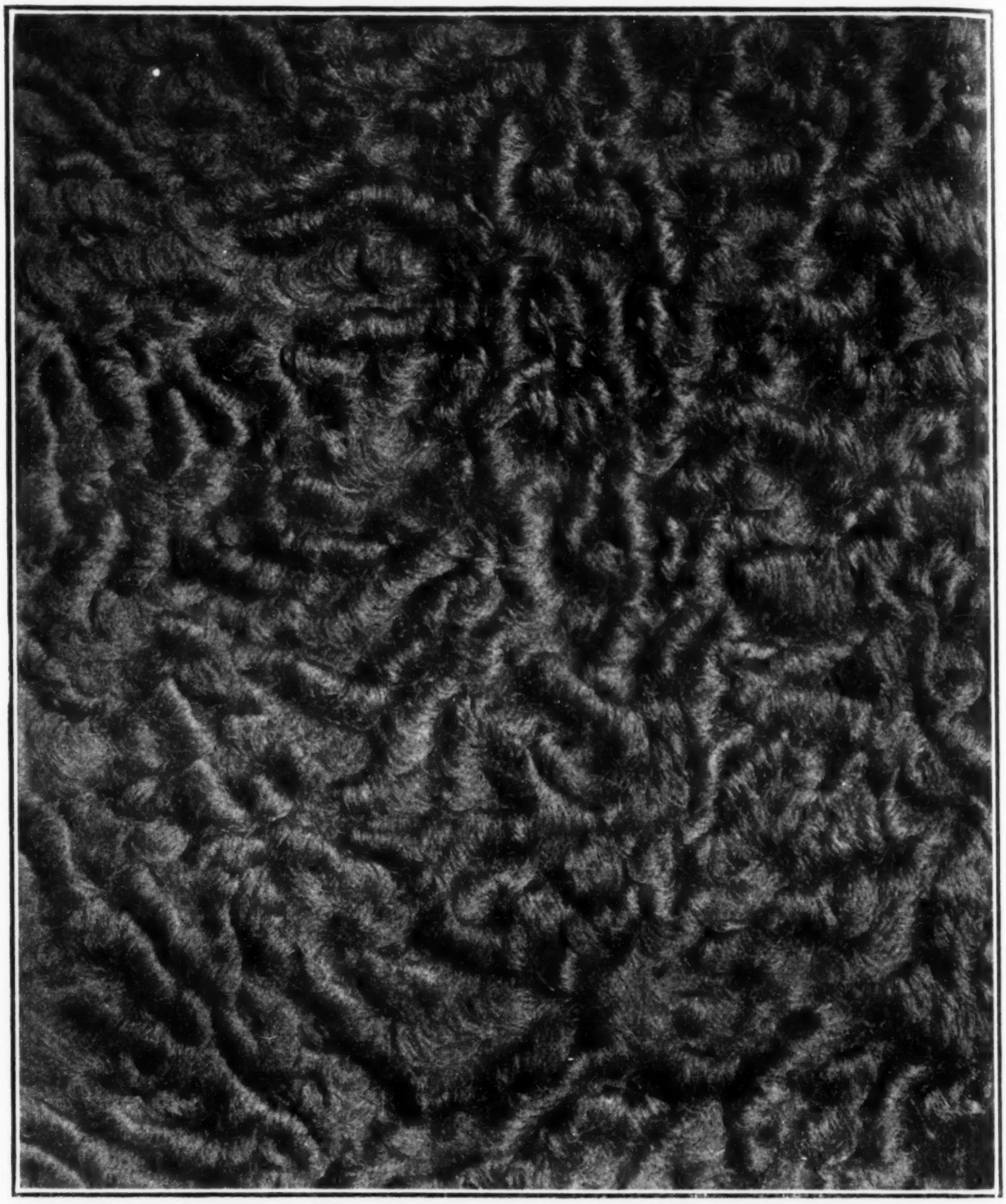


FIG. 4. 75 PER CENT KARAKUL AND 25 PER CENT MERINO-LONGHAIR.

thousands of them are knocked in the head annually on the big sheep ranches, on account of scant pasture, and the dam producing twins and not having sufficient milk. A three-quarter-bred Merino ought to bring a much better price, and I have a three-quarter-bred

Karakuld-Shropshire skin which has been priced at $10. The reason why the Shropshire produces a much prettier skin than the Merino is in my opinion due to the fact that the Shropshire stands between the tight-wool and the long-wool sheep. There is, however, no comparison between a half-bred Karakul-Lincolnshire and a three-quarter-bred Karakuld-Shropshire, and if we wish to excel in luster the best of so-called Persian lamb-skins we must confine ourselves entirely to

FIG. 5. 50 PER CENT KARAKUL AND 50 PER CENT SHROPSHIRE.
This is a magnificent fur, but inferior by far to half-breed Karakul-Lincolnshire.

the long-wool sheep. In my opinion the Lincolns produce the best fur, although the difference in luster between the young Lincoln and Cotswold lamb is hardly sufficiently perceptible to entitle one to a positive statement. It is, however, the opinion of some of the men connected with the U. S. Department of Agriculture, which is now seriously considering the advisability of conducting its own experi-

ments, and for which purpose I have agreed to furnish them with some of my full-blood Arabi rams, that the Leicester and Shropshire will give more luster than any of the other long-wool sheep; but this remains to be determined. I do not believe that we can produce Afghan fur in this country, as it requires a hairy sheep, closely resembling the Mexican goat, which is indigenous to northwestern Turkestan and Afghanistan. It has been suggested to me by the Bureau of Animal Industry that the Barbadoes sheep may furnish us the missing link, and after seeing them I have become convinced that this

FIG. 6. A MAGNIFICENT FUR SUPERIOR TO ASTRAKHAN; 50 PER CENT KARAKUL, 25 PER CENT COTSWOLD, AND 25 PER CENT BLACK-FACED HIGHLAND.

class of sheep will produce a dark brown fur, which may or may not be superior to the Afghan. As the Barbadoes sheep is brown instead of white, which is the color of the Afghan sheep, I doubt very much if we can produce a black offspring.

When a Karakule ram is crossed with any white sheep the offspring is black. A half-breed Karakul generally gives us also a black skin, although this is not always the case, and often the fur is dark gray, resembling a black silver fox. A quarter-bred Karakul, long-wooled,

is gray, producing what is known as Krimmer fur, its price depending entirely upon the amount of luster it possesses; but it is safe to say that the average skin produced by crossing the half-breed Karakul-Lincoln bucks with any of our long-wool sheep will bring $5. This, however, is not the only advantage gained. By injecting 25 per cent of Arabi into any of our native sheep we unquestionably

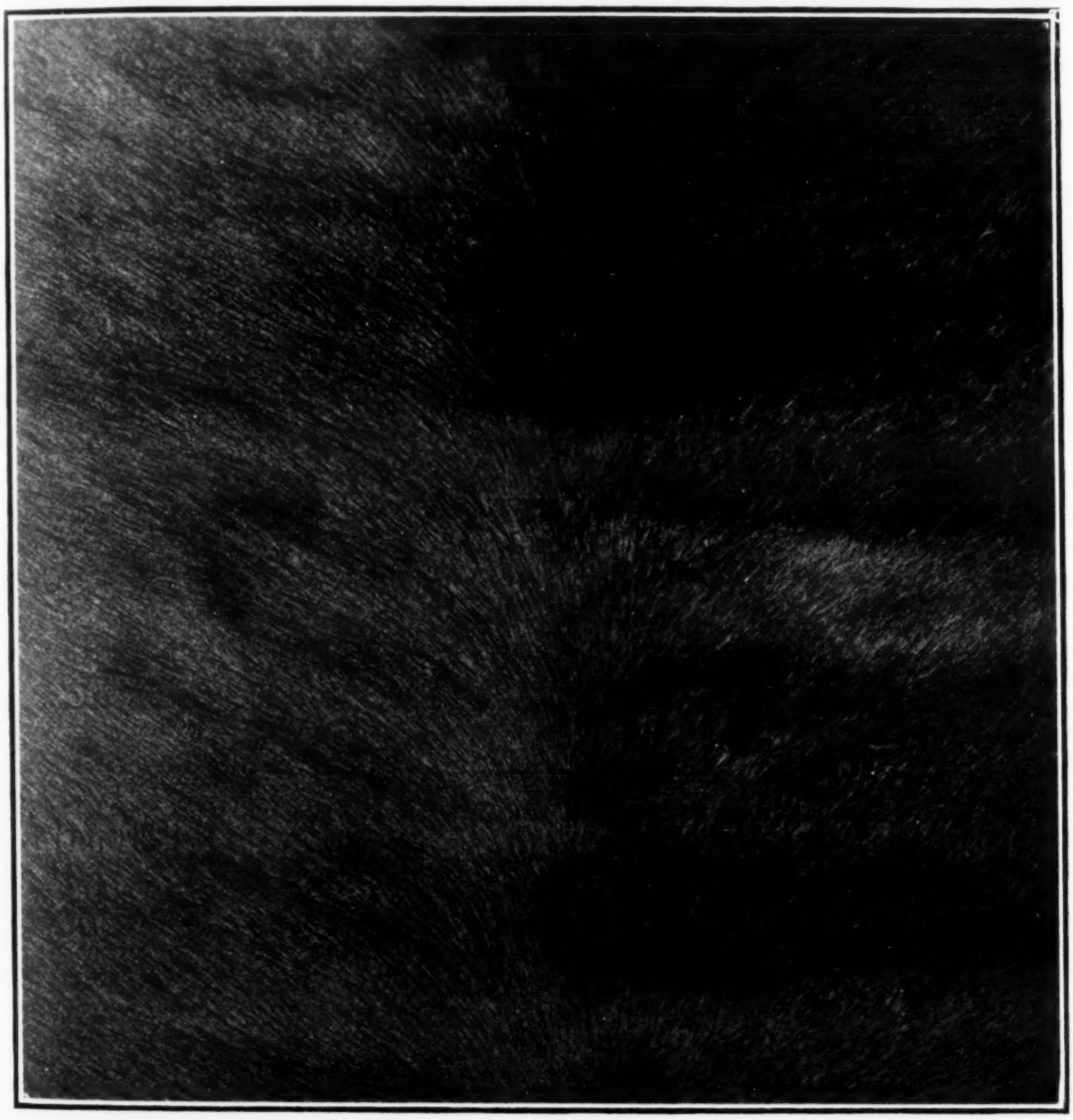


FIG. 7. AFGHAN FUR; 50 PER CENT KARAKUL AND 50 PER CENT COMMON AFGHAN.

produce a heavier sheep with a far superior quality of mutton, and one that is a great deal hardier. This has been amply demonstrated by a number of breeders who have crossed the Merino with a Persian Broadtail, of which there are several hundred in the United States, and the best of which contain from 25 to 50 per cent of Karakul blood. In one instance Persian Broadtail bucks, that should properly be

called half-breed Karakul-Shropshires, were sold to a breeder in New Mexico who crossed them again with Shropshires and sold some of the male offspring to W. W. Burch, owner of the American Sheep Breeders' Magazine, who has a splendid sheep farm in northern Michigan. He crossed these bucks, which could not possibly be considered more than quarter-bred Karakuls, with Delaney Merinos and with Lincoln Delaneys, and this is what he has to say:

FIG. 8. YEARLING FULL BLOOD KARAKUL EWE.

A year ago last fall we bred a Broadtail ram to Delaneys and Lincoln Delaneys. The lambs were a marvel both in size and constitution. They grew rapidly, and in August some of them were larger than their mothers, and went through the most severe drought we have experienced in years, and while the other lambs fell off rapidly in flesh those containing Broadtail blood not only held their own but gained right through the dry season, which lasted for about two months. There was absolutely no grass, and the sheep were obliged to

browse, getting what they could in a burnt-over and cut-over timber country. They seemed to defy cold weather and snow, always preferring to stay out in the storms and lie around in the snow. The mutton proved to be wonderfully sweet, and the finest I have ever eaten. I am satisfied that the fat-tailed sheep will play a very important rôle in our sheep husbandry, and if you can get your Karakul crosses introduced it strikes me that the sheepmen will find not only great profit in wool and mutton, but in fur as well.

The introduction of the Karakul sheep into the United States presents many difficulties, chiefly due to the fact that the fanatical

FIG. 9. FULL BLOOD KARAKUL BUCKS; LOWDEN ON RIGHT BELONGS TO THE LARGE CLASS. FASSIT ON LEFT BELONGS TO INTERMEDIATE TYPE.

Bokharans resent the exportations of the full-blood Arabi, and few of them have ever been taken out of their country. Most all broad-tails that are taken out of Bokhara are sold to foreigners as full-blood Karakuls, when in fact they do not contain more than 50 or 75 per cent of Karakul blood, and belong to a type known as Shirazi, Doozboy, and Zigai, and whilst the Russians have attained wonderful success by crossing this class with their native sheep they do not

begin to give the results obtained from the full-blood Arabis. It would be interesting indeed to ascertain what class of common sheep were used in the production of these three types of broadtails, but there is no history, and one can only surmise they belong to the long-wool family, although in some instances the soft underwool occasionally seen would lead one to believe that the tight-wool family may have contributed its share. If Persia, Afghanistan, northwestern and southwestern Russia are having such wonderful success with the Shirazi, Doozboy, and Zigai, why should we not be able to produce a far superior American broadtail, especially when one takes into consideration the fact that no Asiatic long-hair of the non-broadtail variety possesses the luster of our Lincolns and Cotswolds? As Bokhara is considered as an infected country, chiefly on account of surra, it is very difficult to obtain permission from the Department of Agriculture to import Karakuls into the United States, and if one does succeed they are kept in quarantine for months, which is very expensive. If the writer succeeded in bringing the first flock to this country it is all due to the kindness of ex-President Roosevelt, whose personal letter accomplished wonders in Asia. A ruinous sum, amounting to thousands, was spent to bring the first fifteen head to the United States.

ECONOMIC IMPORTANCE OF LIVE STOCK PRODUCTION

HERBERT W. MUMFORD

University of Illinois, Champaign, Illinois

Sufficient publicity has not been given to the magnitude and importance of live stock production in the United States. One needs only to familiarize himself with the facts with reference to the part this industry plays in the world's commerce, its rational place in the economy of the farm, and its importance as an economic fact in the maintenance of an enticing, permanently profitable agriculture, to become an enthusiast as to its future possibilities. According to the Federal Census of 1900, the capital invested in live stock in the United States is greater than in any other class of property except farm lands.

Class of Property	Value in U. S.* 1900
Farm land with improvements	$16,674,690,247
Live stock	3,078,050,041
Implements and machinery‡	761,261,550
Food and kindred products‡	1,750,811,817
Textiles‡	1,081,961,248
Iron and steel, and their products‡	983,821,918
Lumber and its manufactures‡	547,227,860
Paper and printing‡	419,798,101

*From Statistical Abstract of the U. S., 1908, pp. 124, 178.
‡Value of annual product.

WORLD SUPPLY OF LIVE STOCK

Statistics[1] of the world supply of live stock are incomplete; large areas of Africa are unrepresented; the number of animals in China, Persia, Afghanistan, Korea, Bolivia, Ecuador, Salvador, and several less important countries is unknown; for Brazil the number of cattle alone is estimated; in general, statistics of cattle, horses, sheep, and swine are much more complete than those of other animals, as statements for the world. In some countries the latest available data relate to numbers ten years ago. Keeping in view these deficiencies in data, estimates of the approximate number of live stock in the world, so far as information is available, are of interest.

Sheep seem to be the most numerous of the large animals of the world, with a total of about 580,000,000 head. Australia ranks first, with about 88,000,000; Argentina second with 67,000,000; United States third, with about 57,000,000; European Russia and Asiatic Turkey each have approximately 45,000,000; Great Britain with 27,000,000 in 1908 has more sheep in proportion to its area than any other important nation.

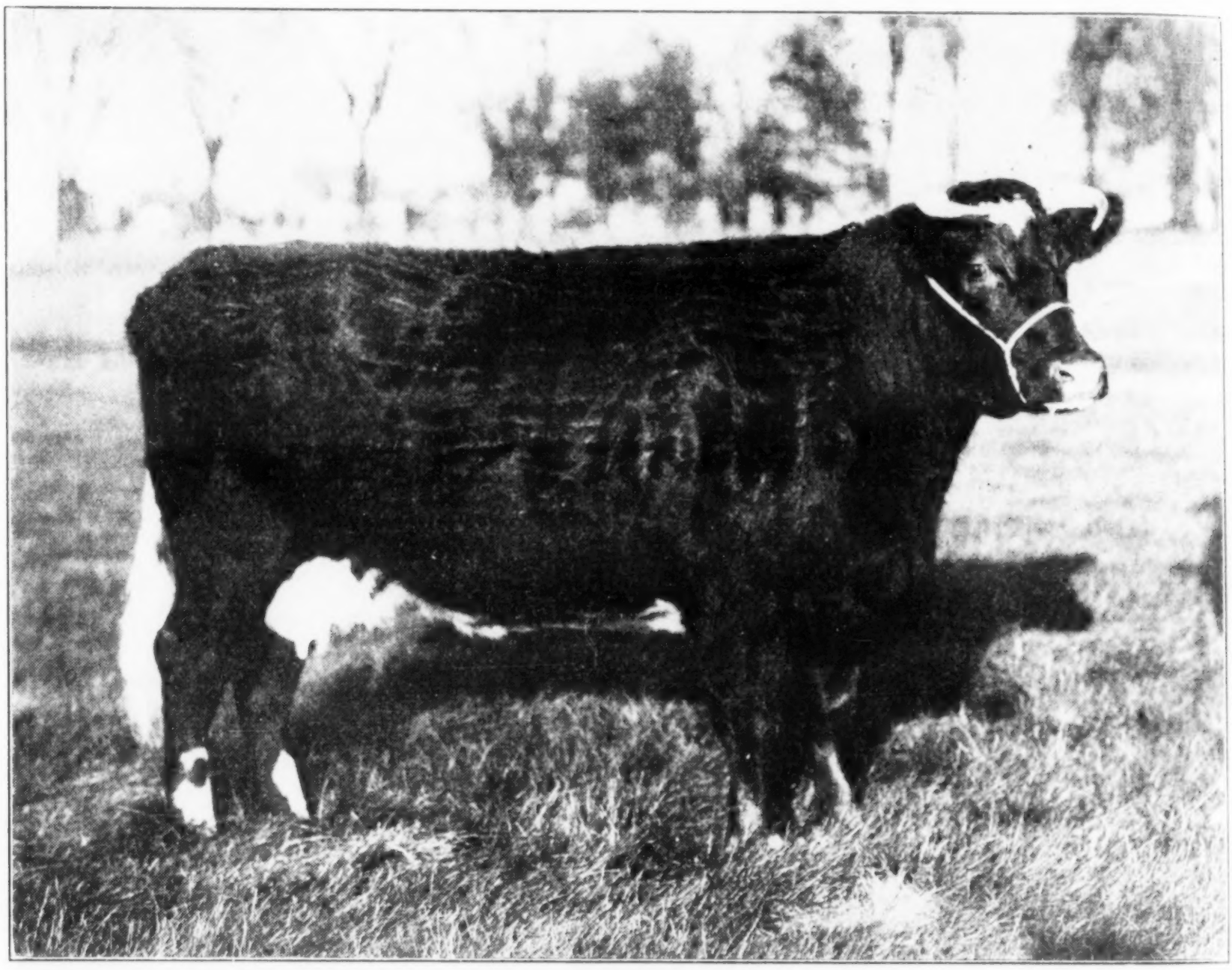
The number of cattle enumerated or estimated, about 430,000,000, although smaller than that of sheep, is much more important, owing to their larger size. In total number of cattle, British India ranks first, with about 91,000,000 (including buffaloes and buffalo calves); the United States ranks second, with about 70,000,000; Russia third, with about 36,000,000; Argentina and Brazil each have about 30,000,000; Germany about 20,000,000; Austria-Hungary 18,000,000 (in 1900), France 14,000,000, and the United Kingdom 12,000,000. The proportion of the total number of cattle which is beef cattle, work cattle, or milch cows has not been estimated.

The United States is preeminent as a swine-producing nation, being credited with approximately 50,000,000 head out of a world

[1]From the Crop Reporter, 1910.

supply of less than 150,000,000; Germany ranks second, with about 22,000,000; European Russia has about 11,000,000; France, 7,000,000; Austria had 5,000,000 in 1900, and Hungary 7,000,000 in 1895. No other country is credited with as many as 5,000,000.

Horses aggregate about 95,000,000; European Russia and the United States have almost an equal number, between 20,000,000 and 25,000,000 head; Argentina has about 8,000,000; Asiatic Russia is credited with about 7,000,000; Germany 4,000,000; France 3,000,000;



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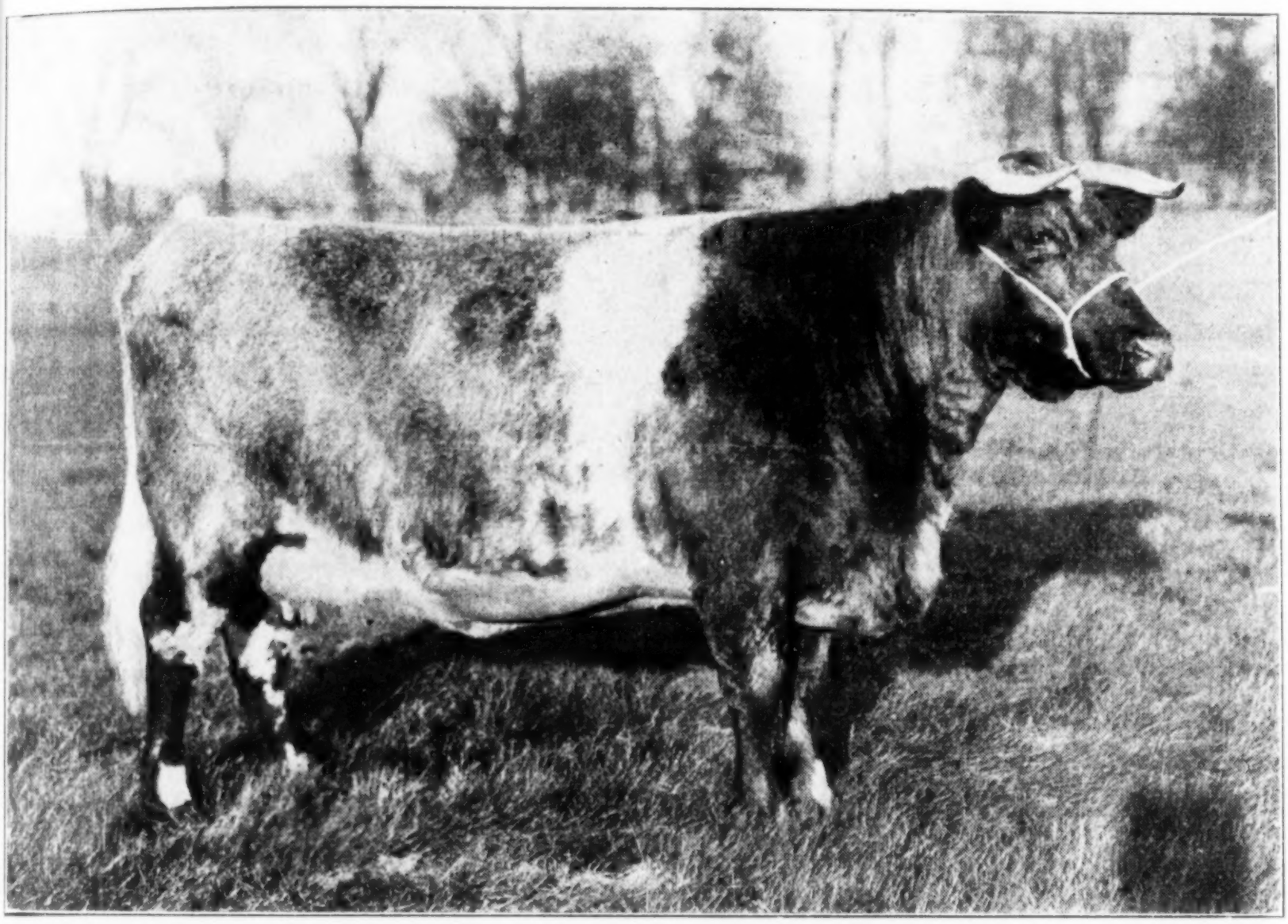
the United Kingdom 2,000,000; Austria and Hungary each had about 2,000,000 in 1900 and 1895, respectively.

Of the 7,500,000 mules that are estimated in the world, more than half are in the United States; no other country is credited with 1,000,000; Spain comes nearest, with about 810,000 in 1907.

These numbers aggregate about 1,260,000,000, in the entire world, while the number of people in the world is estimated at about 1,600,000,000; or about 80 per cent as many domestic animals as people in the world.

There are several ways of making comparisons of the live stock statistics in various countries. It is more or less true that it is quite impossible to make any comparison that would be conclusive. It is interesting, however, to make comparisons from different points of view.



OXFORD NIAGARA 41ST, VOL. 51, P. 1027.

Live stock per capita.

Country	Date	Horses	Cattle	Sheep	Swine
The world	.....	0.06	0.27	0.36	0.09
Germany	1810	.08	25	1.22	.15
	1903	.08	.36	.13	.39
France	1852	.10	.16	.93	.14
	1908	.09	.19	.44	.18
Denmark	1881	.17	.74	.78	.27
	1903	.19	.73	.35	.57
Holland	1850	.08	.36	.25	.07
	1897	.06	.32	.18	.23
Italy	1852	.08	.16	.29	.08
	1890	.07	.17	.23	.06
United States	1867	.14	.51	1.02	.64
	1909	.23	.81	.64	.62
Illinois	1901	.23	.58	.20	1.02
	1909	0	.59	.14	.80

These statistics do not indicate that as population becomes more dense there is a necessary decrease in live stock.

There is a sense in which it is true that the live stock per capita decreases. It is in the early history of a country when the population is small and extensive systems of live stock production largely constitute the agriculture of the country. In such instances population frequently increased more rapidly than live stock. When, however, the conditions demand the establishment of intensive forms of agriculture it appears as in Germany, France, Denmark, Holland, Italy, and the British Isles, that there is a tendency, with but few exceptions, for live stock per capita to increase rather than decrease.

*Live stock and population per square mile.**

Country	Date of Census	Population	Total Live Stock	Horses	Cattle	Sheep	Swine
Belgium.....	1907	643.4	279.8	21.5	157.4		100.9
Holland.....	1907	454.0					
British Isles	April 1901 Live stock 1908	345.8	404.0	17.7	96.3	256.7	33.3
Italy.....	1908	306.7					
Germany...	Dec. 1905 Live stock Dec. 1907	290.4	262.0	26.7	99.4	36.7	165.2
France.....	1906	189.5	201.6	15.2	68.1	84.3	34.0
Denmark....	1906	167.0	298.7	31.1	118.0	56.2	93.4
United States....	1900 Live stock 1908	25.6	67.8	6.7	23.9	18.4	18.8

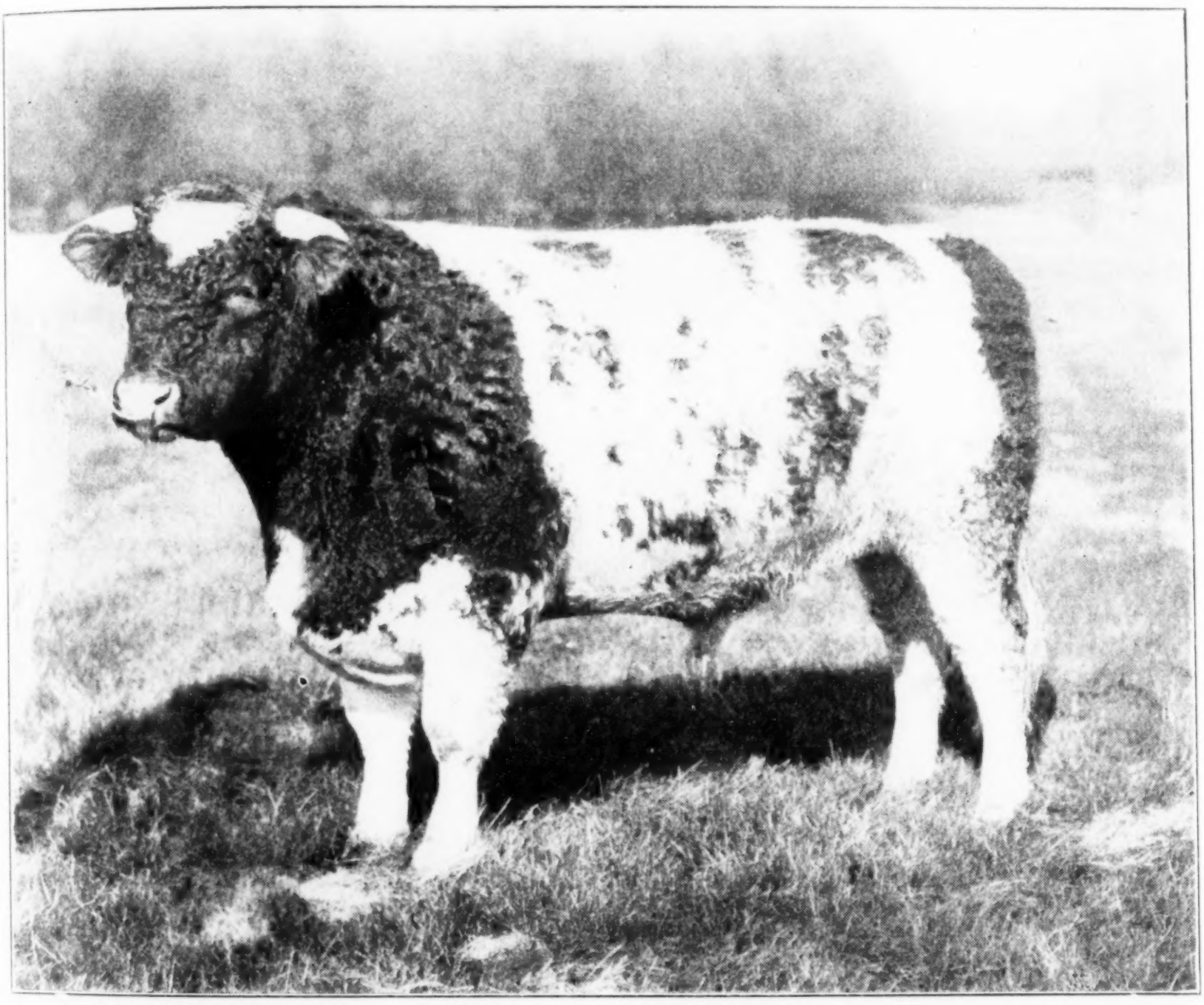
*Mules and goats not included because relatively unimportant in most countries.

From this table it appears that there is ample opportunity in the United States to develop a greater animal husbandry. It is true that in most of the countries cited it has been possible to maintain an important live stock industry only because it has been possible to purchase cheap feeds from the United States and elsewhere.

Live stock production must have been found profitable else it would have long since been discontinued. Would it not be well for the farmers of the United States to realize fully that it is not good economic policy to permit their animal foodstuffs to be exported to increase the profits of the farmers and fertilize the farms of these older countries. If favorable conditions for live stock production in the United States could be maintained, every pound of feed produced here that is suitable for live stock production should be converted into live stock, and if economic conditions are not such as to

encourage a more extensive production of live stock on the farms of the United States, it should be the business of the federal government to see that conditions are favorable.

The live stock producers of the United States should be given the most favorable opportunity indefinitely to supply the growing demand in this country for animal products. This will most certainly mean that raw materials suitable for live stock, produced more cheaply



SHORTHORN HERD BULL CORNELIUS 304322.

in other countries than in the United States, should be available to the live stock farmers of the United States at the lowest possible cost, and that they should not be obliged to compete in our markets with finished animal products. Such competition will discourage live stock production, it will render grain farming less profitable, because after all is said, live stock production is the principal outlet of our corn and hay crops. Should live stock production cease to be profitable, the margin of profit in grain growing would be so greatly

reduced that farmers of the United States could not produce grain at a profit and at the same time maintain the fertility of their lands. Sooner or later the fact will be recognized that for many years in this country it was possible to buy agricultural products at a price which was but little above the cost of the labor involved in their production.

When it is known that in the ten years, 1901-1910, the population of the United States has increased 20.52 per cent, while live stock has increased only 10.27 per cent, it is clearly evident that, if it is good policy to develop in this country an important animal husbandry, it is time the government should turn its attention to fostering the industry. With a rapidly increasing population, certain forms of animal production will naturally be supplanted by others, but these new conditions which are being imposed on the live stock producer as a result of increased population have thus far but increased his difficulties.

The subject of the economic importance of live stock production is capable of more expansion than the limits of this article will permit. In closing, however, attention should be called to the fact that in the future more attention will be directed to the relation of live stock production to the economic operation of the farm, with especial reference to the better distribution of labor, the profitable utilization of the residues or by-products of grains grown and the fertilizing value of farm manure.

A NEW METHOD OF HANDLING POLLEN

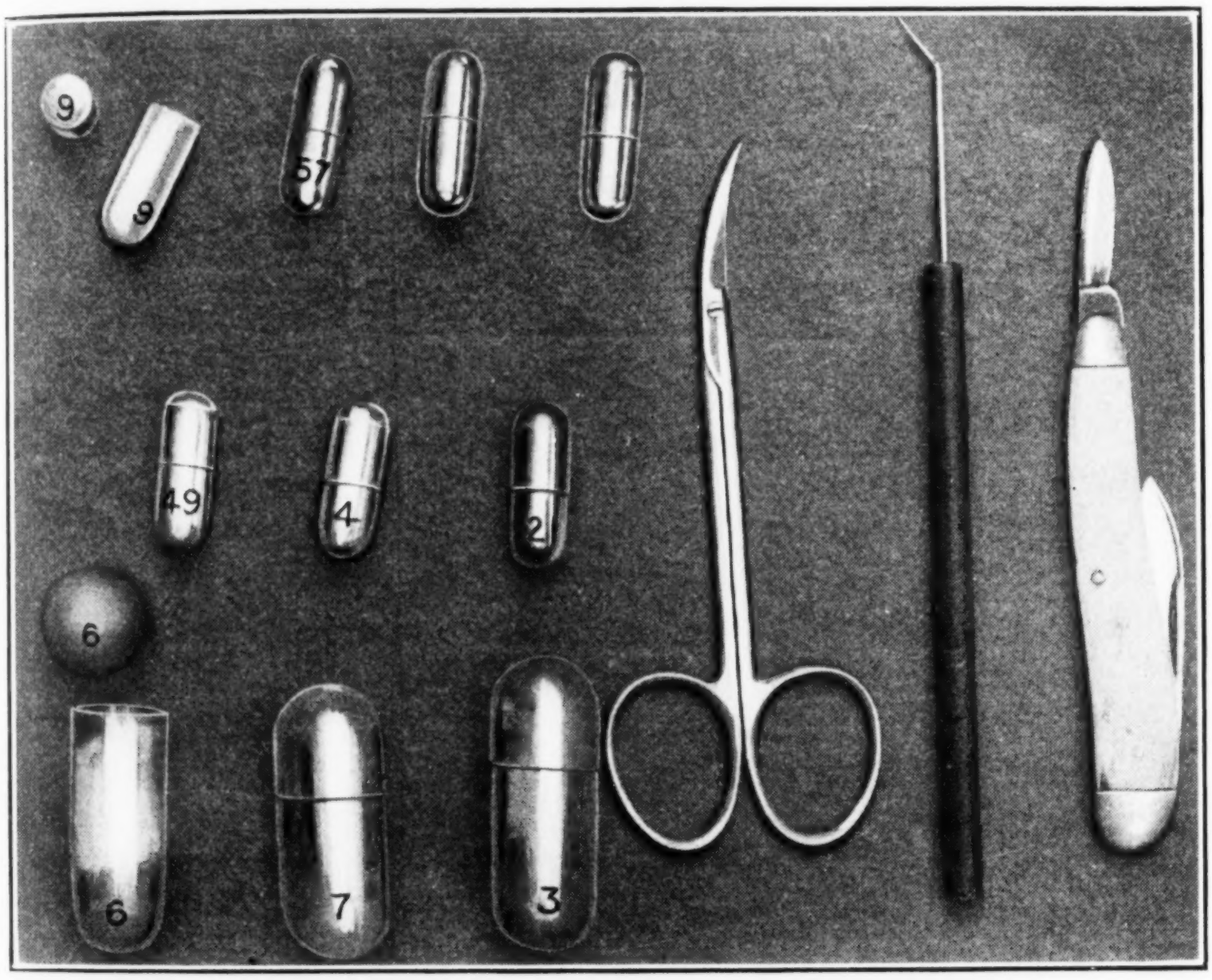
STEPHEN N. GREEN

Ohio Agricultural Experiment Station, Wooster, Ohio

In the spring of 1908, having large numbers of apple, peach, plum and other blossoms to cross and self-pollinate, I was greatly hindered and suffered many losses by the failure to have sufficient pollen on hand at the critical period. The usual method of collecting a fresh supply at each operation was very slow and clumsy. After trying every possible way of collecting and preserving pollen I accidentally found a very simple method, which during three seasons has proven almost ideal.

Empty quinine capsules seem to meet the requirements under almost all circumstances for gathering and storing pollen and they are

convenient to use. These capsules can be obtained at all drug stores at a very slight cost. In most cases the smaller sizes will do. Anthers of the desired female parent are selected as near the bursting point as possible, and scarped or cut into a capsule. The capsule can then be lettered or numbered with india ink or a small slip of paper inserted with note as a record. These capsules can be thrown loosely into a small box or arranged to suit personal taste. In a few hours the anthers in the capsule will burst and a shake will scatter



CAPSULES AND TOOLS USED IN THE PROCESS.

the pollen around, which will adhere uniformly over the gelatin walls inside the capsule, where it can be transferred to stigma with the usual brush or thin-bladed knife. I have found a knife the better tool, as an abundance of pollen can be gathered on its point for transference and it is instantly cleaned. Pollen can thus be very quickly applied to larger pistilled flowers, such as peach, plum, etc.

Pollen in these capsules is available at a moment's notice regardless of outside conditions. A large supply is on hand and in compact shape. A capsule once filled will often last the entire season. It is

surprising the length of time pollen will retain its vitality when so enclosed. These capsules are small and light and can be mailed without trouble. Thus the plant breeder can extend his field of operation by using pollen gathered, for instance, in California and mailed across the continent.

Pollen from almost every flower with which I have worked can be stored and successfully used from these capsules, with the exception perhaps of some of the Cucurbitaceæ. Some pollen from this family seems to be so very moist and sticky that it does not readily separate from the anthers when they are cut before bursting and it does not adhere satisfactorily to the capsule walls.

A NEW METHOD OF CORN POLLINATION

H. F. ROBERTS

Kansas Agricultural College, Manhattan, Kansas

In the breeding of corn, some difficulties are encountered in the technique of pollination, in respect to the prevention of contamination of the silks by foreign pollen, carried on the hands or instruments of the operator, as he goes from plant to plant engaged in the work of artificial pollination. To obviate these difficulties the following method has been devised by the writer, and has been used with success this season at the Kansas Experiment Station. The simplicity of the method and its complete effectiveness seem to justify a description.

The tassel is covered while still immature, and before the anthers have protruded, with a ten-pound manila paper sack such as is commonly used in grocery stores. The mouth of this sack is securely gathered around the stalk beneath the tassel and pinned. For this purpose we find a rather stout long pin sold loose in quarter-pound boxes under the trade name of "Celebrate," size MC, to be the most satisfactory. Ordinary pins are too small and light. The ear is likewise covered with a similar sack, which is drawn tightly over the top of the ear, folded around the stalk on the opposite side and the folds pinned. The sacking of the ear *must be done before the silks have begun in the least to protrude from the husks.* Otherwise pollination of the protruding silks from vagrant pollen is almost certain to occur.

When the silks have grown to a length of five or six inches within the sack, the ear is usually in the best condition for pollination, since

by that time most of the silks have grown out. Inasmuch as the tip of the ear is its youngest portion, the ovaries (grains) are progressively older from tip to base. The first silks to appear, therefore, are

FIG. 1a. MANNER OF SACKING TASSELS AND EARS.

those from the basal kernels, and so on progressively outward, the tip silks being the last to develop. In natural wind pollination of corn, the pollen is blowing about the field for a period of a week or

ten days, during which time the drifting pollen falls on the successive silks as they appear. In artificial pollination, if but a single application of the pollen is made, naturally only those silks (stigmas) will be pollinated which happen to be developed and receptive at the

FIG. 1b. MANNER OF SACKING TASSELS AND EARS.

time. The consequence is seen in a "nubbin" ear. For this reason, the same ear is usually gone over by the pollinator two or three times, in order to secure the successful pollination of the greatest possible number of stigmas.

In the method devised by the writer, it is believed that a greater number of silks can be reached in one pollination, and that the danger of contamination from foreign pollen is practically eliminated.

The pollen is applied to the silks by means of a common insect powder "gun" or spring blower. The blower best adapted to the purpose and which has been used by the writer is the sort known as "Quick Loader," manufactured by the American Can Co. This blower, unlike most others of the sort, which are filled through a hole in top or bottom, comes apart in halves, making it possible both to load quickly and to get at the interior easily for cleaning out,—an absolute necessity in corn-pollination work.

The blower is filled with anthers and pollen from the sack taken from the tassel, the latter being bent over and rapped sharply to secure the shaking off of the loose anthers and pollen.

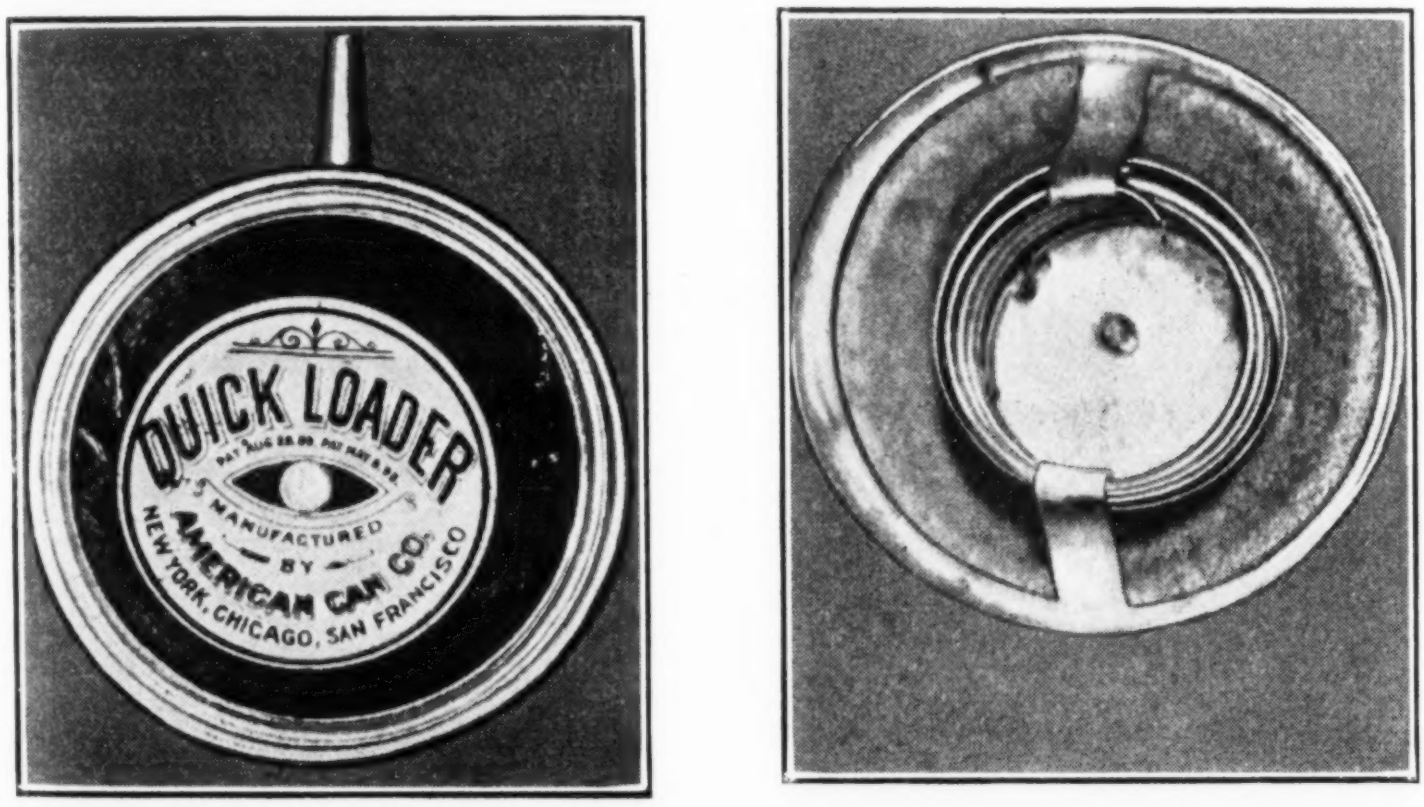


FIG. 2. POWDER GUN USED FOR APPLYING POLLEN.

In the sack the pollen is of course mixed with the mass of empty anthers from which it has been shed. No especial care, however, need be taken to get the pollen separated from the anthers. By having the nose of the blower cut down to a length of half an inch, any anthers which may chance to clog the nozzle can easily be pushed out with a pin. As a matter of fact, for the most part the blast expels pollen and anthers together without difficulty. In cutting down the blower nozzle, which any tinsmith can do, the mouth of the nozzle should be drawn down to the size of the original aperture of the nozzle. Otherwise the opening will be too large, and the air pressure insufficient.

This device has a compression spring attached to its upper half, and a lacquered or varnished cloth tissue allows for the compression of the metal disk above. This upper half of the blower is treated by boiling in paraffin until bubbles cease to come up from the fabric. By this treatment the paraffin, instead of merely coating the surface of the cloth, goes thoroughly into the fiber of the threads. The

FIG. 3. METHOD OF POLLINATING.

blower can now be left in 95 per cent alcohol for the purpose of killing the pollen grains which stick to the sides and the cloth top after use. The blowers were first used without being treated with paraffin, but it was found that the alcohol gradually dissolved the varnish on the outside of the cover, rendering it sticky and disagreeable to handle. Finally, no doubt, the dissolving of the varnish, which gives

an air-tight surface to the cloth, would render the blower less effective, by letting the air through the fabric during compression.

Boiling in paraffin not only seals the cloth more effectively, but also completely protects the varnish from the alcohol, even after an immersion of fifteen or twenty minutes. It is absolutely necessary to adopt some method of killing the pollen grains left after one pollination before proceeding to the next plant. By the use of the hands in pollination, as is frequently the practice, dipping the hand into the mass of pollen and sowing it over the silks with the fingers, it is not only difficult to reach all of the exposed silks, but it is impossible to sterilize the hands afterward with certainty. Simple washing of the hands in alcohol is insufficient to insure the killing of all the pollen grains that may adhere to them.

Pollination by the use of a camel's-hair brush is slow and tedious, it is difficult to reach all of the silks rapidly and satisfactorily, and the surfaces of the silks have to be continually touched. Sterilization of the brush is of course possible by leaving it long enough in alcohol, but the other objections are sufficient to condemn the method. Pollination by simply shaking or pouring the pollen from the sack upon the silks is wasteful, the pollen cannot be directed at will, and it is impossible to reach all of the silks with certainty.

By the use of the insect gun as a means of artificial pollination, complete sterizilation is possible after each operation. In our practice one pair of workers uses three blowers, one being in operation, another, which has been sterilized, being exposed to dry, and a third, the one which has last been used, lying submerged in the alcohol vessel. This gives each blower about fifteen minutes to lie in the alcohol—a time which we find to be more than amply sufficient to completely kill every pollen grain that may lurk in any crevice or in the nozzle or which may adhere to the cloth of the lid.

Aside from the ease with which sterilization can be effected, the blower method is decidedly superior to any other method known to the writer of artificially pollinating corn, in that the pollen is much more economically and effectively used. The blast, with its stream of pollen, can be directed at will into all parts of the mass of the silks, and they can be pollinated thoroughly from base to tip without being touched by the hands, with the consequent danger of injury to their delicate cells.

In our experiments two operators engage together in the work of pollination. One removes the tassel sack, empties the pollen into the blower, and then holds the sack under the mass to catch the waste

pollen that falls during the operation of pollinating. The second operator does the work of pollinating, but is careful not to handle the sack of pollen or to use his hands in any way that would endanger their becoming dusted with pollen. Immediately after pollination, the remaining contents of the blower are emptied back into the tassel sack, the latter is again fastened over the tassel, and the ear is sacked and tagged. The blower is then left in the vessel of alcohol, and the one which was last taken from the alcohol and left to dry is used for the next operation. Working in this manner two men can pollinate eighteen plants an hour with practically no risk whatever of carrying pollen on the hands and of contaminating the successive crosses. It should be stated that the danger from flying pollen is eliminated by detasselling all of the stalks not sacked, before the work of artificial pollination is begun.

THE GENETICS CONFERENCE AT PARIS

What promises to be the most important meeting ever held on Heredity is to take place at Paris, September 18–23. Many of the leading plant and animal breeders and students of evolution in Europe have signified their intention of being present. It is desirable that Americans make a creditable showing at this Congress. Membership fee of 25 francs, or $5, entitles to participation in the meetings and excursions, and to a copy of the proceedings. Those not expecting to attend can receive the proceedings for 15 francs *if sent in advance of the meeting.* Later the price will probably be raised.

Any who desire to take part in the Congress or to receive the published proceedings should send at once the 25 francs or 15 francs, as the case may be, to the Secretary of the QUATRIEME CONFERENCE INTERNATIONALE DE GENETIQUE, M. PHILLIPE DE VILMORIN, 66 RUE BOISSIERE, PARIS, FRANCE.

It is probable that many articles in the published proceedings will be in English. The volume is likely to be much appreciated by students of heredity.

EDITORIALS

THE SECOND VOLUME OF THE MAGAZINE

With the beginning of the second volume of the *American Breeders Magazine* some of the plans which were formulated during the last year are being put into effect and the *Magazine* promises to be much better in 1911 than it was in 1910. The substance, dignity, and tone of the *Magazine* are mainly the product of those who contribute to the annual meeting or directly to the *Magazine*. The formative period of the *Magazine* is not fully past nor is it even desirable that it should for some tine assume the fixed individuality peculiar to older periodicals. The endeavor will be to cast the contents of the *Magazine* more along popular lines than heretofore, leaving the scientific and technical contributions mostly to go into the Annual Report.

Under the new plan the bound annual report of the Association will be mailed early in the year. This change will result in the *Magazine* being made up of new matter furnished by the membership after the Annual Report is issued, and necessitated calling upon members for contributions especially prepared for the *Magazine*. This call has been met with a splendid response and the four or more numbers of the *Magazine* for the ensuing year promise to be of unusual interest and value. Through this new arrangement of publishing different matter in the *Magazine* and in the Annual Report, the total amount of original matter placed before the members year by year is largely increased. The *Magazine* and the Annual Report will thus supplement each other and each will possess a peculiar value of its own.

A GENETICS MAGAZINE

The *American Breeders Magazine* has demonstrated that a genetics magazine has a place among the periodicals of the day and has fully justified the purpose of its existence. While its field is broad and is touched in part by numerous periodicals, it has a major field which encroaches upon the main domain of no one of them. The *Magazine* has been received very favorably on all sides. It has helped to place before the public the work of the American Breeders Association and in this way has been instrumental in a substantial increase in membership during the last year. The reviewers have given it credit for

maintaining a high standard, both of subject matter and of literary and typographical form. With its growing constituency both of contributors and of supporting members the standard will be raised and maintained at a higher level than during the last year.

THE NEW EDITORIAL STAFF

The shifting of a portion of the editorial responsibility to Messrs. Webber, Mumford, and Davenport, secretaries, respectively, of the Plant Section, the Animal Section and the Eugenics Section, together with the election of Mr. Knorr to the position of editorial secretary, materially strengthens the editorial work on the publications of the Association. All members are especially requested to send notes and news of vital interest in connection with problems of heredity and breeding. Persons who have in mind papers for the *Magazine* or addresses for the annual meeting should communicate early with the respective committees, section secretaries, or the secretary of the Association.

FRANCIS GALTON

News comes of the death of Francis Galton. He had reached an advanced age—eighty nine—retaining his intellectual vigor and activity to the last. Through his work he has not only enriched science, but has so amplified several of its departments as to leave a lasting impress.

His creation of the new science of eugenics, for which he not only supplied the name, but outlined in large part the methods of research, is alone sufficient to earn for him a place by the side of Darwin and other masters immortal in science. Later generations will be in much better position to comprehend the full meaning, the importance and vastness of the thought of pressing science into service in the betterment of human heredity.

It is gratifying to know that the American Breeders Association, the first body of scientists to give recognition officially to the new science of eugenics and the first to set to work a large number of scientists for specific research work in eugenics, should four years ago have done honor to Mr. Galton by electing him as honorary life member.

By a strange fatality, Mr. Galton leaves no descendants and the line of descent, which on his maternal side traces to Erasmus Darwin, the half cousin of Charles Darwin, is extinguished with his death. A portrait of Dr. Galton and a brief biographic sketch were published in no. 2, vol. 1, of the *American Breeders Magazine*.

IMPERIALISM IN DEMOCRACIES

The bulk of the power of a republic rests with the people, who can arise en masse and sweep aside the most powerful organization managed by the mightiest of leaders. The people conserve and accumulate their own dearly won power, which they guard with jealous care as against that imperialism which claims the divine right of kings. The people install leaders, surround them with lieutenants and support them with votes. They build up parties and install governmental machinery. They temporarily invest very large power in their rulers, and they hold them to account. They do not allow their elected officers to claim the right to remain in office except by the will of the people.

Republics grow into colossal communities, intricate beyond measure, yet with the leading forces so organized as to serve each and all the people. New ideas, which are ever springing from man's mind, are cast into the ever evolving social organism, and are soon assimilated. Evolution in a republic, as in plant and animal organisms, in part comes by sudden mutations, and each mutation is assimilated and evolved into symmetrical forms by almost imperceptible steps day by day and year by year. Some profound changes which have suddenly come in mechanical lines are printing, steam, telegraphy, electric power, telephony, aerographs, and flying; each in its turn having seized the public mind, which has absorbed, digested, and adapted it to the multifarious uses of which it is capable.

Human heredity, like heredity in plants and in lower animals, changes by means of occasional wide mutating leaps followed by slow evolutionary adaptation a small step at a time. Thus most men are average in ability, and one in ten thousand is above ordinary ability and one in a million is a genius. When a genius and a new idea are in combination a general mutating movement occurs.

Situations arise in which men secure wonderful opportunities and seize almost imperialistic power. Thus Washington dictated nationalism, Lincoln dictated emancipation, and Roosevelt dictated a fight on greed. In political life men are followed with a devotion which is almost frenzy. And temporarily the leader has the power to direct the affairs of state. Some men use this imperialistic power to the advantage of all people. Occasionally men who are unduly avaricious for power or money greatly abuse the public confidence, just as crowned kings often rule solely for their own benefit and not to benefit the ruled.

In the world of art a genius becomes the center of a new school of expression, whether it be in oil, in sculpture, in music, or in architecture. His imperialism is idealistic rather than material and political.

The great mind in science, invention, art, oratory or literature creates a great mutation in the affairs of men and thus an upturn in civilization arises from the leadership of a single person. True, the times must be ripe, just as the great oration can only spring from the able speaker under the fortuitous combination of the man and the occasion.

Mutation seems to be the evolutionary milestone of all organisms. In heredity the mutation has two elements. There must be an individual of exceptional or peculiar development; and it must have the power to project into its progeny its own exceptional values. An imperialistic thought which brings to man a new conception of large import has in it the first of the two elements named. And as it goes forth and affects the minds and the material interests of men its values are comparable with those organisms which are true mutations. But human mutations in the heredity sense are exceedingly rare. One can point to but few geniuses who begot geniuses. Among all kinds of organisms there is one rare individual in thousands or in tens of thousands. But of these rare individuals only one in many has the second element,—that of being able to project its excellence strongly into its progeny.

MUTATIONS—INDIVIDUAL AND GENETICAL

The imperialism of the genuis or of the mutating plant or animal is indeed marvelous. These steps toward perfection are inspirational. They demonstrate that heredity is as substantial an entity as metal, mineral, or soil They prove the power of the inner spirit of things. They lead toward the conception of the unity of all energy.

ACKNOWLEDGMENTS OF COURTESIES

The American Breeders Association is under lasting obligation to numerous herdbook associations, horticultural societies and other organizations, also to many private business firms, for the cordial spirit of coöperation with which they have met the American Breeders Association in its efforts to enlarge its membership. Special appreciation is hereby expressed for the courtesies extended by the secretaries of the following organizations:

Holstein-Friesian Association, Brattleboro, Vt.
American Hampshire Sheep Association, Cold Water, Mich.
American Cotswold Registry Association, Waukesha, Wis.

American Hackney Horse Society, New York, N. Y.
American Berkshire Association, Springfield, Ill.
American Shropshire Registry Association, Lafayette, Ind.
American Carnation Society, Indianapolis, Ind.
American Leicester Breeders Association, Cameron, Ill.
The R. M. Kellogg Co., breeders of strawberries, Three Rivers, Mich.
West Virginia State Horticultural Society, Morgantown, W. Va.
Indiana Horticultural Society, Lafayette, Ind.

Much good will result from these cordial relations, and it will immensely facilitate the propaganda of the American Breeders Association for the better understanding of the laws of heredity and their application to practical breeding to the end that large economic results may be achieved. The *American Breeders Magazine* will assist in every way possible the enlargement and the betterment of the work of breed associations, and we are pleased to note that the secretaries of the various associations are beginning to coöperate with the American Breeders Association.

EXTENDING THE ORGANIZATION OF THE AMERICAN BREEDERS ASSOCIATION

Professor Levi Chubbuck, of Denver, Colorado, transmitting the membership fees of eleven new members for 1911, writes that some time in February a number of new and old members of the Association met in Denver for the purpose of organizing a Colorado section of the American Breeders Association. A constitution has been drafted for this affiliating organization and plans have been made to start the branch association with an even hundred members. Much useful and effective work is certain to come from this new organization. The successful launching of this branch organization points the way in which the American Breeders Association can be extended in other states, and has led to plans which will make it possible for existing breeders' associations, of which there are many, to affiliate if they desire, with the national organization.

By extending the genetics propaganda of the American Breeders Association through organization of genetics associations, and placing in the hands of this entire membership the publications of the Association, a tremendous power will be started for progress in science, in agriculture, and in social and economic betterment.

The interest of thousands of persons will be aroused in questions of heredity, in the breeding of plants and animals and in eugenics.

The mind of the general public is becoming receptive to the vital facts of heredity in man and is showing evidences of appreciation of the work of the skilful breeder of plants and animals.

ORGANIZATION OF COÖPERATIVE BREEDING

American agriculture is generally on a basis of individual ownership by the family of a small tract of land, such as the members of the family can manage mainly with their own labor. There are occasional large estates and these are scattered throughout all parts of the country, and in some portions of certain states large farms constitute a considerable proportion of the entire area. A few people, who have the European idea, predict that the land will gradually drift into the hands of the wealthy in the form of large estates. But wherever the Caucasian race has settled in new territory without the presence of an inferior race the plan of family farms has been generally adopted and racial progress has there been most rapid. On the other hand, where there has been an inferior race, the large farm estate has been the rule and racial progress has been less rapid. New Zealand, Canada, and the northern United States are examples of countries where the family farm plan prevails and where the most rapid racial progress in the world is taking place. South Africa and the southern United States are examples of countries where the large estate was more generally developed. Many reasons might be cited in favor of the family farm plan as against the large estate in most if not in nearly all parts of the world where the soil is cultivated. It may be a part of the white man's burden to help develop country life in the entire world on the family farm basis.

Nearly all people who know the better side of country life conditions where the family farm prevails regard the production of folks as the principal crop. The trend of the philosophy of our times is to urge people to return to the soil. This does not mean that they should return and be farm laborers on large estates, but that they become owners and managers of farms and farm homes. There are a few lines of farm business which at times seem to drift under the form of organization of the large farm or the large fruit ranch. The invention of large and complicated machinery sometimes seems to lead to the organization of farming under large units with a high degree of division of labor.

But on the whole the individualistic farmer holds his own and pays more per acre for the land for a combined home and business than the owner of money is willing to place in the land as simply a commercial

investment. Certain it is that twenty independent homes on owned farms make for a stronger country life civilization than does one beautiful farm mansion, one manager's house, and twenty laborers' cottages. Besides the better aggregate of home life in the twenty independent homes, they also support better schools, more virile churches, a more excellent social organization; a more highly conserving political status exists and the output of folks is a better trained, more hopeful class of young people, more highly inspired and supplied with a larger aggregate of money with which to start in life for themselves.

For the family farms to compete better in mere commercial production with the plan of the large estate the farmers must learn how to do collectively some of the things which the large estate can best do because of its centralized organization. In other words, that the farmer may retain the vital part of his individualistic status, and own most of the land as family farms he must give up portions of his individualism and merge them into coöperations which he and his fellow-farmers manage collectively.

There is need of laws and a new jurisprudence of coöperation. At present coöperative enterprises must organize, operate, and be closed up, under corporation laws which are not adapted to the form of organizations known as coöperations. These new laws should facilitate the organization of coöperations. They should better provide for the conduct of business by coöperative organizations, and, quite as important, they should provide for reorganization in case of temporary embarrassment, in place of the harsh closing-up processes provided under laws which relate to corporations.

During recent years coöperation has entered into the breeding of domestic animals. This is one of the most significant phases of coöperation. Much of the work of testing individual animals, of securing superior purebred sires, of creating new strains and breeds, and of preserving unmixed the choicest breeding blood as sources of breeding animals with which to grade up the best stock everywhere, can be done far better under coöperative organization than by the individual farmer alone. As in other lines of coöperation, much coöperation in animal breeding will aid in preserving to the farmer the individualistic business of breeding pedigreed animals. But the plans for this coöperative breeding go even further, and have included coöperation by state experiment stations and by the national Department of Agriculture with the farmers. And under this several forms of coöperation in animal breeding have been developed in this country.

Coöperation in breeding up the farm herds of the neighborhood is best exemplified by the cow-testing associations of Denmark and later of Michigan, Wisconsin, Connecticut, and other states. The principal features of this plan are that a group of about twenty-five farmers employ a man trained in testing the values of cows. By visiting the farms periodically he determines the amount of milk given for the month and the amount of butter fat produced, thus securing data from which are calculated the annual product of milk and butter for each cow. He also gets a close approximation of the amount of food used by each cow and determines its value. The difference between the cost of food and the value of product determines the rating of the cow, in net dollars of income. As the generations of cows come and go these performance records furnish also a basis for the valuation of each cow as a producer of cows, and also of each bull as a producer of cows—and also of sires. The cowtesting inspectors and intelligent farmers soon learn the significance and value of the recorded figures fashioned into pedigree performance tables. They are led to scrutinize the evidences of the breeding efficiency of bulls offered for sale as sires of other herds. Very rapidly the poor cows are eliminated from the herds; and the blood of the very best sires and dams is rapidly multiplied so that the herds are brought up to a high average of earning efficiency.

COW-TESTING ASSOCIATION

FINANCING THE MAGAZINE FOR WIDER USEFULNESS

For more than a dozen years the Secretary and many other loyal members of the American Breeders' Association have labored diligently and without remuneration, for the upbuilding of the Association and as a result of their expenditure of energy and time, the organization is now well established. It has gained a substantial place in the scientific organizations of the world.

The American Breeders' Association, being a coöperative organization, utilizes for its own purposes all fees paid by members, all moneys given by friends, and all services freely given it by the earnest workers who are putting forward the science of heredity and breeding. The life membership fees of $20 each, which must be invested and only the income from which may be used, now amount to about $3000.

The publications of the Association have maintained a high standard of scientific and practical excellence. The six bound Annual Reports already published, and the seventh, now in press, contain

the most important body of knowledge extant on genetics and practical breeding. The *American Breeders' Magazine*, now in its second year, is taking its place as a periodical of the widest importance. The present issue is an earnest of what can and will be done by this publication as a Genetics magazine, when a large membership supplies the means with which to develop it.

The movement under the leadership of the American Breeders' Association should be rapidly expanded. The important need of the present is publicity, and through it a larger membership. To get a large membership, funds must be made available to employ a Membership Secretary who will devote his entire time to securing members. For this purpose an investment of $5,000 is now needed. A subscription list has been opened and in this issue the appeal is made for subscriptions of $100 each. Fifty men each of whom is able to give $100 are earnestly requested to coöperate with the officers of the Association in assuming the burden of placing the American Breeders' Association in a position from which it will grow into a very large and powerful organization. All are urged to aid in this effort to secure a campaign fund. Old members are still more earnestly urged to secure new members.

COÖPERATION IN ANIMAL BREEDING

We have a class of large general associations of the breeders of pedigreed animals called herdbook associations. These are essentially coöperative organizations and they have done an immense service to American live stock. They have successfully kept the lineage pedigrees of the breed secured from Europe or originated in this country. Yet, they have had some shortcomings. They, for too long, depended exclusively on lineage pedigrees as evidence of breeding efficiency.

Beginning with the work of John Wallace in putting trotting horse pedigrees on a basis of performance records, followed up by the advanced registry scheme of dairy herdbook associations, we are developing a class of herdbook organizations which are gradually paying more attention to inherent efficiency and to performance record additions to all pedigrees. Too long have the leaders in our great live-stock papers, in live-stock chairs of our agricultural colleges, and the orators in the live-stock sales ring adhered to the evidences of excellence which are made up by the prices received in the sales ring and by the prizes secured at the live-stock show. These

ADVANCED REGISTRATION

are excellent evidences, but they too often relate only to the visual individuality of the given animal rather than to its inherent breeding efficiency. The animal phenomenal in individuality, rather than the animal phenomenal in the power to project excellence into his or her progeny, is given the larger consideration. The broader plan of the future will not give less consideration to individual excellence, but it will give far greater prominence to the breeding power as based on the average record of performance of ancestors, of collateral relatives, and especially of progeny. There is need of the most searching scientific, almost cold-blooded, investigation of the present status of pedigree herdbook associations and the philosophy of their methods, and to show how they may more effectively improve the respective breeds. Certainly they will find it advantageous to extend all such coöperative work as may help them build up the average excellence of the respective breeds; that pedigrees, far more than now, may be the compelling evidence which causes all growers to use purebred or first generation hybrid stock.

One class of coöperative breeders' associations is the so-called sire-owning associations. Under this form of organization a number of farmers or breeders form an organization under which they collectively own a group of sires. These sires are kept at places where they can be most conveniently and most advantageously used by the respective members. Members of the association, or employed experts, are chosen to make the wisest possible selection of sires. Records more or less complete are kept of the values and performance of the progeny of each sire under systems which permit of the comparison of the breeding value of the respective sires. Sires which show progeny only medium in value are at once discarded. Sires which beget young of especially high average value are retained as long as they are fit for service. They are rotated among the herds so as to avoid any inbreeding which experience may prove unwise.

SIRE-OWNING ASSOCIATION

Another type of coöperative breeding is found in the so-called circuit breeding scheme. This plan best provides for creating marked new values. It utilizes all the advantages of the three other plans and all here supplement each other. And all lead under the scheme for circuit breeding to the discovery of those rare animals, one in perhaps many thousand, which serve as mutative bases of new families and of new values advanced above any values before available. As outlined in two projects already started, one with milking Shorthorns in Minnesota, the other with Holstein cattle in North Dakota, the

United States Department of Agriculture, the state experiment station and local breeders are organized into a triangular form of coöperative association. The management of the work is vested in a council composed of one member appointed by the Secretary of Agriculture, one appointed by the director of the state experiment station, and one chosen by the farmers who form the coöperative breeding circuit association. The Department of Agriculture and the experiment station each make an annual cash contribution toward paying the salary and expenses of a circuit superintendent, chosen by the council, and possibly provide some expense money to help pay the expenses of securing superior male animals from a distance. The coöperative association is made up of about twenty breeders. Each breeder contracts with the association and with the coöperating institutions that he will enter into the circuit a minimum number of circuit "approved" animals. In case of cattle, he agrees also to breed, care for, feed, and test his animals under the supervision of the circuit superintendent. He agrees that the superintendent, acting under the council, shall divide all animals into three classes. Those which are not considered fit for registration will be classed as "discarded" and are not eligible for use as registered animals. Those which are not chosen for the circuit breeding will be called "registered" and will be accredited to the national herdbook of the breed for registration there, and those which are deemed of greatest value to be used in the circuit breeding will be called "approved," and will, of course, also be registered in the national herdbook. Members will further promise the department and the station that "approved" animals shall be offered for sale only for use within the circuit, while registered animals may be sold to persons ouside the circuit.

Under this plan, with some help from public funds, the circuit can secure the best blood of the breed to be found in the country or even to be found in other countries. By rigid tests and valuations of each animal from birth to maturity the value of the different lines of blood brought into the circuit can be determined. In case strains are found of remarkable value, they can soon be made the basis of stock of the entire circuit. Under plans for not too narrow breeding, this blood can then be kept intact permanently.

A PERPETUAL FOUNT OF NEW BLOOD

In case that anywhere in herd test associations, in sire-owning associations, in the advanced registry work of herdbook associations or in the unattached private herds or in other circuits of the same breed, a phenomenal blood strain is discovered, the circuit can secure this blood and test it within the circuit.

NEWS AND NOTES

MALADJUSTMENTS IN SECOND-GENERATION HYBRIDS

In the South one frequently hears the statement that the first cross between the white and the black races is vigorous and healthy but that the subsequent generations descended from these mulattoes are weakly and highly subject to diesase. While the fact that an opinion is general does not necessarily prove it to be true, there are theoretical reasons for suspecting that the opinion referred to in this case is true. There is also experimental evidence to substantiate it, at least in species other than man.

In the first-generation hybrid all the characters of both races are present, and there is opportunity for the development of a normal organism more or less intermediate between the two parent races. This is especially true for those characters which blend whether they segregate later or not; but for characters in which there is marked dominance we might have a given organ of the body much more like one of the parent races than the other, while another organ of the body might be more like the other parent race, thus giving more or less maladjustment. But in the second and later generations we may get any combination of the original parent characters. This might, and doubtless does, frequently result in some of the organs of the body being strikingly like those of one of the parent races while other organs would be as strikingly like the other parent race.

Where the two races differ markedly in respect to vital organs or vital processes, we may thus have serious maladjustments. We of course do not know the complete Mendelian relations of any entire organism, hence there is very little definite to be said about what the maladjustments would be. We might, however, have in an organism of a second-generation hybrid a heart similar to that of one parent race and lungs similar to those of the other parent race, and these two organs—the heart and the lungs—might not be adapted to work together normally. So we might have differences between any vital organs or vital processes whereby the various parts of the organism are not properly correlated.

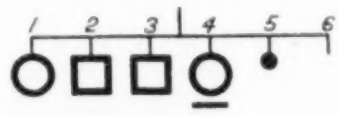
Some very interesting evidence bearing on this point was obtained by Mr. Q. I. Simpson in his hybridization work with European wild

hogs and our domesticated breeds. The first-generation hybrids were exceedingly vigorous, and evidently their various vital organs were well correlated with each other. But in the second generation of these hybrids, as well as in pigs produced by crossing the hybrids with either of the pure races, new Mendelian combinations of characters caused various organs to be poorly adjusted to each other. For instance, some of the pigs had the greedy appetites of domesticated hogs with the small digestive apparatus of the wild hog, and died from over-eating—a thing a domesticated hog seldom does, because he has a digestive apparatus commensurate with this appetite.

It seems probable from the evidence at hand that Mendelian recombination in the second and later generations of hybrids between distinct races may frequently result in maladjustments that may have serious consequences for the organism.—W. J. SPILLMAN, *Washington, D. C.*

CONVENTIONAL SYMBOLS FOR PEDIGREE TABLES

At a meeting of persons interested in pedigree work among defectives, held at Lincoln, Ill., last spring, supplemented by a meeting held at Skillman on October 14, the following conventional signs in pedigree tables were adopted: □ Square, male. ■ Affected individual, male. ○ Circle, female. ● Affected individual, female. ○—□ A union of circle and square by a horizontal or oblique line, marriage. Miscarriage or still-birth would be indicated by a small solid dot. All members of a family would be connected by a short vertical line with the same horizontal line. Order of birth would be indicated by a figure placed above this horizontal line.



In case sex is unknown, circle or square is to be omitted. Underscoring a circle or square indicates institutional care. The following letters are employed, to be placed inside the circle or square. If two letters are employed, that representing the more important or primary condition to be inside the circle or square and the remaining letter or letters to be placed outside.

A, alcoholic.
B, blind.
C, criminal.
D, deaf.
Dwf, dwarf.
E, epileptic.
F, feeble-minded.
I, insane.
M, migraine.
N, normal.
S, syphilis.
SX, grave sexual offender.
T, tuberculosis.
W, wanderer, tramp, truant, etc.
b, born.
d, died.
m, married.
d. inf. (inside of circle or square), died in infancy.
illeg., on vertical line means illegitimate child.

A numeral inside the circle or square indicates a number of persons of that sex grouped together to save space or because little is known about them.

d. early is to mean (*a*) in the case of feeble-minded, died before 7 years; (*b*) in the case of epileptic, died before 14 years; (*c*) in the case of insane, died before 25 years.

Wherever epilepsy is present the E is to be placed inside the circle or square, and any other condition or future developments to be placed outside the square.

Institutions working on similar defective families in the same state are to exchange data.

Unclassifiable conditions which are abnormal are to be indicated in the charts by the striated circle or square, and, in tabulating, the condition is to be explained and not to be passed over with the application of a descriptive term.—C. B. DAVENPORT, *Cold Spring Harbor, N. Y.*

SOME CYTOLOGICAL CORRECTIONS

As the members of this Association are all interested in cytology, I desire to call attention to some errors that still pass current as facts in most text-books on cytology and heredity. The first of these that I shall mention is that there is a specific number of chromosomes in the germ cells of organisms.

In his late papers Dr. Wilson states:[1]

> The most conspicuous departure from the relations to which we have become accustomed lies in the fact that different individuals of the same species often possess different numbers of chromosomes, though the number in each individual is constant. An even more surprising fact is that in all of my own material every male individual possesses at least 22 spermatogonial chromosomes, including a pair of unequal idiochromosomes like those of the Pentatomidæ, while in Montgomery's material of *M. terminalis* every male has but 21 spermatogonial chromosomes, one of which is typical odd or "accessory" chromosome (unpaired idiochromosome).

The second error is that the gametes have an equal number of chromosomes. That is, the spermatozoa have one-half the number of

[1] Journal Exp. Zool. VI, p. 147.

the fertilized egg. It is now known that there is dimorphism in spermatozoa in many species of animals. Examples, Orthoptera, Homoptera, and Heteroptera, etc.

The third error is that the chromosomes may be used by the taxonomist in classification. Dr. Stevens states:[2]

> It has become evident in the course of the work that little dependence can be placed on the present classification of the aphids and that a reclassification based on the cytology of the germ cells may be necessary.

Dr. McClung states in speaking of the germ cells of a grasshopper:[3]

> There are thus within the germ cells of these animals certain structures that show specific, generic, and family characters in just as pronounced a manner as do the completed organisms wherein they are formed.

T. H. Montgomery states:[4]

> The conviction almost forces itself upon one that chromosomal relations not only furnish the basis for any understanding of the process called heredity and differentiation, but also bid fair to become the basis of taxonomy.

Dr. Lillie:[5]

> The chromosome group of the species contains the sum total of material transmitted from one generation to another. Each chromosome represents in each stage some property of the entire organism.

Dr. Wilson states:[6]

> In the genus Banasa a much greater numerical difference exists between two species that are otherwise so similar as sometimes to have been confused by systematists, though the examination of a large series has convinced me that they are always distinguishable by structural characters. These species are *B. calva* and *B. dimidiata*, of which the former has typically 26 chromosomes, the latter 16. But the most remarkable case, and the one to which I would direct special attention, is that of the common and widely diffused form *Thyanta custator*, in which two types of chromosome groups exist in a species which competent systematists have not thus far been able to differentiate even into two varieties. Individuals taken at Madison, New Jersey, show in the male 27 chromosomes, in the female 28; while all those from Georgia, South Carolina, Tennessee, and Colorado have in both sexes but 16. No intermediate numbers have thus far been found. This species is a very variable one in respect to shape, size, and color, and all the western forms and many of the southern ones differ noticeably from the New Jersey ones. Nevertheless, Van Duze, the well-known specialist of Pentatomidæ, who has kindly examined

[2]Studies on the Germ Cells of Aphids. Carnegie Pub. No. 51.
[3]Cytology and Taxonomy. Kansas Univ. Sci. Bull., Vol. IV, No. VII.
[4]Science, Jan. 5, 1906
[5]Journal Exp. Zool., p. 262.
[6]Differences in the chromosome-groups of closely related species and varieties, and their possible bearing on the "Physiological Species."

the series, states that he is unable to find in the external characters any line of demarcation by which the individuals of the 16-chromosome type can be separated from the others.

For the past three years I have taken great interest in spermatogenesis in insects, having worked upon and photographed the chromosomal complex in Aphidæ, Pentatomidæ, Coreidæ, Lygaeidæ, Acrididídæ, Gryllidæ and Chrysomellidæ. I find differences apparently as great in the size, arrangement, and number of chromosomes as I do in external characters of a species.—L. C. BRAGG, *Ft. Collins, Colo.*

TERMS OF THE GALTON BEQUEST

Sir Francis Galton, F.R.S., who died on January 17, aged 89, has left his residuary estate to the University of London for the purpose of encouraging the study of national eugenics. This residuary estate will amount to about £45,000. He left property of the gross value of £115,932, of which the net personalty has been sworn at £113,371.

In a codicil Sir Francis Galton describes the scope of his new foundation in the following terms some technical phrases being omitted:

I devise and bequeath all the residue of my estate and effects, both real and personal, unto the University of London for the establishment and endowment of a professorship at the said university to be known as "The Galton Professorship of Eugenics," with a laboratory or office and library attached thereto. And I declare that the duty of the professor shall be to pursue the study and further the knowledge of national eugenics—that is, of the agencies under social control that may improve or impair the racial faculties of future generations physically and mentally. And for this purpose I desire that the university shall, out of the income of the above endowment, provide the salaries of the professor and of such assistants as the senate may think necessary, and that the professor shall do the following acts and things—namely:

1. Collect materials bearing on eugenics.
2. Discuss such materials and draw conclusions.
3. Form a central office to provide information, under appropriate restrictions, to private individuals and to public authorities concerning the laws of inheritance in man, and to urge the conclusions as to social conduct which follow from such laws.
4. Extend the knowledge of eugenics by all or any of the following means, namely, (*a*) professorial instruction; (*b*) occasional publications; (*c*) occasional public lectures; (*d*) experimental or observational work which may throw light on eugenic problems.

He shall also submit from time to time reports of the work done to the authorities of the said university.

I also declare that the said university shall be at liberty to apply either the capital or income of the said moneys for any of the purposes aforesaid, but it is

my hope that the university will see fit to preserve the capital thereof wholly or almost wholly intact, not encroaching materially upon it for cost of building, fittings, or library. Also that the university will supply the laboratory or office at such place as its senate shall from time to time determine, but preferably in the first instance in proximity to the biometric laboratory. I state these hopes on the chance of their having a moral effect upon the future decisions of the senate of the university, but they are not intended to have any legally binding effect whatever upon the freedom of their action. And I declare that it shall be lawful for the senate of the said university, if they shall think fit so to do, to postpone the election of the first or any subsequent professor of eugenics for a period of not exceeding four years from the date of my death, or from the date of the occurrence of any vacancy in the office as the case may be.

I declare it to be my wish, but I do not impose it as an obligation, that on the appointment of the first professor the post shall be offered to Professor Karl Pearson, and on such conditions as will give him liberty to continue his biometric laboratory now established at University College.

PUBLICATIONS RECEIVED

DOMESTICATED ANIMALS AND PLANTS. A brief treatise upon the origin and development of domesticated races, with special reference to the method of improvement." Dr. Eugene Davenport, dean of the College of Agriculture, director of the Agricultural Experiment Station, Champaign, Ill. 321 pages, illustrated. Ginn & Company.

A text-book on the principles of breeding as applied to our domesticated animals and plants, and written for use in high schools, normal schools and for the general student. This book is an abridged and simplified form of the larger and more technical work "Principles of Breeding" by the same author. It fills the place of a much needed text-book on this subject, especially at this time when many of these institutions are expanding their courses of study by adding agriculture. Most excellent use is made of everyday biological facts and their relation to human affairs is attractively and interestingly presented, and throughout the book there runs a current of wholesome philosophy.

Five pages are devoted to instruction "to the teacher." A summary and list of exercises concludes each chapter. Many references are given for use of the reading student. A glossary of technical and scientific terms in the appendix is very useful in view of the fact that the rapid development of the science of heredity is creating and constantly adding difficult new words expressing new conceptions of heredity phenomena.

The author has succeeded not only in presenting the subject of breeding, and of domesticated plants and animals in pedagogical

form, and bringing it down to high-school grade, but he has succeeded in telling it interestingly, so as to hold the attention of the general reader. Dean Davenport's two books mark the new movement in texts relating to breeding, and ere long texts, laboratory work, demonstration breeding, and the results of research in relation to heredity will have gained for this subject a large place in our schools. Since the study of heredity will be both a "culture" study and a vocational study it will gain a large place in our educational system. Dean Davenport's pioneering work is most valuable, both because of the excellence of his books and because they blaze the trail in this subject.

THE IMPORTANCE AND IMPROVEMENT OF GRAIN SORGHUMS. Carleton R. Ball, agronomist in charge of grain sorghum investigations. Bul. No. 203, Bureau of Plant Industry, U. S. Department of Agriculture.

EUTHENICS AND EUGENICS. Dr. C. B. Davenport, Cold Spring Harbor, N. Y. Reprinted from *The Popular Science Monthly*, January, 1911, pages 16 to 20.

LITTLE TRIPS TO THE HOMES OF GREAT HORSES. Hambletonian 10. Arthur Calton Thomas, Equine Publishing Co., Omaha, Nebraska.

"HEREDITY" OR PARENTAL ENDOWMENT—SOME GENERAL LAWS. Dr. Pauline Myers, Marshalltown, Iowa, 39 pages.

HEREDITY OF SKIN PIGMENT IN MAN. Gertrude C. Davenport and Charles B. Davenport. Reprinted from *The American Naturalist*, Vol. XLIV, November and December, 1910, pages 642 to 731.

DEGENERATION, ALBINISM AND INBREDDING. Charles B. Davenport. Reprinted from *Science*, n. s., Vol. XXVIII, No. 718, pages 454 to 455, October 2, 1908.

CALIFORNIA'S NEW INDUSTRY, GROWING HUMANS. Bulletin of California State Board of Health. Vol. 6, No. 5, illustrated, pages 265 to 369.

CATTLE BREEDERS' ASSOCIATIONS IN DENMARK. Frederick Rasmussen, Bull. 129, Bureau of Animal Industry, U. S. Department of Agriculture. 40 pages.

FORTY-SIXTH ANNUAL REPORT OF THE QUEENSLAND ACCLIMATISATION SOCIETY, Brisbane, Australia. Report covers period August 1, 1908, to March 31, 1909. 34 pages. Mr. Nicol Robinson, honorary secretary.

A BIOMETRICAL STUDY OF EGG PRODUCTION IN THE DOMESTIC FOWL. Raymond Pearl and Frank M. Surface. Bul. 110, Part II, Bureau of Animal Industry, U. S. Department of Agriculture. Pp. 81 to 170.

SEEDS AND PLANTS IMPORTED DURING THE PERIOD FROM OCTOBER 1 TO DECEMBER 31, 1909. David Fairchild, Agricultural Explorer in Charge. Bureau of Plant Industry, U. S. Department of Agriculture, Bul. 205. 1911. 54 pages.

ASSOCIATION MATTERS

PRINTS OF PORTRAITS FOR FRAMING

There have recently come to the office of the Association a number of orders for single copies of the *Magazine* from persons who desire to frame the portraits of the noted men whose biographies have been published. To meet this demand a limited number of these portraits have been printed on a fine quality of enameled translucent India sepia paper in sepia tone. The effect is very pleasing. The size of these portraits is 6 by 9 inches and they may be mounted, panel-fashion, in sets of four or more, so as to be suitable for hanging in class-rooms or dens. While the supply lasts, copies may be had from the Secretary's office at exact cost price, 10 cents each or $1.20 for the entire set of 12. These prices include postage. The following are the names of the subjects of the twelve portraits:

Charles Robert Darwin, Gregor Johann Mendel, Amos Cruikshank, Francis Galton, Pierre Louis Francois Leveque de Vilmorin, John H. Wallace, Joseph Gottlieb Koelreuter, Robert Bakewell, Wilhelm Rimpau, Ephraim Wales Bull, Peter M. Gideon and Joseph Lancaster Budd.

BACK NUMBERS OF THE ANNUAL REPORTS

Proceedings of the American Breeders Association, Annual Reports Nos. IV and VI, may be obtained from the Secretary at $2 per volume. In the case of Annual Report No. VI, this price also covers the four numbers of the *American Breeders Magazine* so long as the supply of the latter publication lasts.

EXTENDING A. B. A. MEMBERSHIP

A small, neat card containing on one side an invitation to join the American Breeders Association and on the reverse side a blank application for membership is being sent out by the Secretary in any desired quantity to members interested in increasing the membership and who will insert these cards in letters with their correspondence. These invitations if signed by the nominating member may carry considerable weight in inducing others to join. In many cases

these slips may serve to call the attention of persons to the work of the Association who before had no knowledge of its existence. These slips are letter size, put up in neat pads of about seventy and will be supplied on request to any member or others interested.

Notices for renewal of memberships are being mailed from the office of the Secretary and members are requested to assist in simplifying this part of the office work, as well as reducing the expense connected therewith, by remitting their 1911 membership fees promptly on receipt of notice. If possible, the fee for at least one new member should accompany each renewal.

OPINIONS

The *Magazine* is good and ought to have a large circulation.—JOHN W. TITCOMB, *Commissioner, Department of Fisheries and Game, State of Vermont.*

I am very glad indeed to see that the *Magazine* is giving so much attention to eugenics. The subject is one in which our people should be a great deal more interested than they are at present, and the American Breeders Association can do a splendid work by keeping the matter prominently before those whose immediate concerns do not take them into this most important field. The last number of the *Magazine*, which I have read very carefully, is a most satisfactory one. In my talks on eugenics, of which I have given several in this vicinity, I mention the American Breeders Association, and the *Magazine*, as deserving the support of everyone who has any concern for the welfare of the race.—ROBERT DEC. WARD, *Harvard University, Cambridge, Mass.*

I wish to express my appreciation of the excellent matter contained in the Reports and in the *Magazine*.—JOHN BELLING, *Assistant Botanist, Agricultural Experiment Station, Gainesville, Fla.*

I congratulate you on the splendid magazine you are getting out. It is a gem. I like the plan of giving the short biographical sketches and pictures of breeders. This will in time form a valuable reference, otherwise not available to most of us.—W. A. HARSHBARGER, *Washburn College, Topeka, Kansas.*

I think the American Breeders Association is doing about the most valuable work of any of the important organizations of this country. For the work in principles of breeding which is given to the seniors in this institution, I very frequently refer to the reports of the American Breeders Association.—ALFRED ATKINSON, *Department of Agronomy, Montana Agricultural College, Bozeman, Mont.*